THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
German Submarine Cable Enterprise	281
The Medical Employment of X-Rays	282
Conduit Wiring for Electrical Installations	284
Correspondence	284
Legal	287
Business Notes	288
Electric Lighting at Tientsin (*illus.*)	301
The Dartford Light Railways (*illus.*)	304
City Notes	306
Market Quotations	312
Stocks and Shares	312
Share List of Electrical Companies	313
Exports and Imports of Electrical Goods during Jan., 1906	315
Proceedings of Institutions:—	
Technical Considerations in Electric Railway Engineering (*illus.*)	316
Gas Engines as Applied to Electric Driving (*illus.*) ...	317
New Electrical Devices, Fittings and Plant (*illus.*)	319
Electro-Chemical and Electro-Metallurgical Progress in 1905 (*continued*)	321
Effective Shop Lighting (*illus.*)	322
German Submarine Cable Enterprise	323
New Patents Applied For	324
Published Specifications	324

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GERMAN SUBMARINE CABLE ENTERPRISE.

THE article which we publish elsewhere on the above should, we venture to think, be read with interest, and possibly advantage, by any Englishmen who consider that submarine telegraphy is a field in which British manufacturers and engineers have a monopoly which can be comfortably relied on as a permanency. As happened in the case of Italy and France, the need for submarine cables led to the establishment of a German factory and to the building of German ships, with a result, at least in this case, which must be admitted as most creditable to all connected with the undertaking.

There has never been any need up to now to fear foreign competition in the manufacture of submarine cables, and all the British manufacturer has asked has been a fair field and no favour. But this latest German enterprise suggests at least that we should be on the *qui vive* lest, thanks to many advantages they possess, and to the support which is given them by their government, our neighbours succeed in stealing a march on us.

There appears to be every reason why cables should be as cheaply manufactured in Germany as in England. Iron or steel wire, which is the chief item in most cables, at least as regards weight, is mostly manufactured in Germany, and, indeed, a large proportion of that used in the construction of English cables is supplied by the very firm mentioned as having started the Norddeutsche Seekabelwerke. Copper wire is cheaper in Germany than in England, gutta-percha and india-rubber are as much in the hands of German merchants as any others, and the other minor component parts are hardly worth considering.

As everyone knows, the Thames, on whose banks are the works of all the English companies, is a very unfavourable locality, and these companies are heavily handicapped by an amount of taxation which is imposed nowhere else, and which is wellnigh insupportable. At the last general meeting of the oldest cable manufacturing company, the chairman stated that a saving of £25,000 a year in taxation would result if their works were moved to the Tyne, and at the same time pointed out that this amount, if capitalised, would suffice for the erection and equipment of works of the best modern design in a more favourable neighbourhood.

Added to the difficulty as regards taxation, there is another which is intimately connected with it, namely, the high rate of wages and the poor quality of much of the labour obtainable. Germany is not a cheap place, take it all round, but wages are lower and the class of labour better. A friend of ours who spent nearly a year on the German telegraph steamer *Stephan* told us that during that time he never saw any member of the ship's crew the worse for liquor either on board or on shore. That is a great deal to be able to say, and even if the English sailor may be a

smarter man and generally more experienced, most shipmasters, if they studied their own convenience, would prefer the German.

There is just a suspicion in our minds that some of our manufacturers may be taking things too easily and failing to keep themselves thoroughly up to the times in regard to both machinery and ships. One hears of electric motors driving all the cable machines at Nordenham, of X-ray apparatus for examining core and joints, of electric welding for the sheathing wires and so on, and one cannot help being struck with the difference between such modern methods and the equipment of some of our cable factories. In ships, too, the difference is still more marked. Compare the *Stephan*, as described in *Engineering* for March 25th and April 8th, 1904, with several of ours which, despite the admirable work they accomplish, can hardly be said to be of the highest efficiency.

All such modern features are, of course, to be expected with a company which has just made a start, and has had the sense carefully to adopt the best of everything, no matter of what nationality, but surely experience should have taught us the importance of not running any danger of being left behind.

Some years ago Sheffield and Birmingham felt German competition very seriously, because they were slow to wake up to the fact that improved machinery was constantly required. Now they not only hold their own, but can successfully compete against the cheapest German manufactures. The penny scissors which are just now to be bought in many stationers' shops are a good illustration; they are not made in Germany, but in Birmingham. This, of course, has little bearing on the matter, and has not much to do with submarine cables, in the manufacture of which great care and skill are required; but with the facts we have mentioned, and with the recent feat accomplished by Germany—that of making and laying over 6,000 miles of submarine cable without a fault, and almost without a hitch—we think we are justified in giving the matter considerable prominence, and in sounding, not the "alarm," but the "réveillé!"

THE MEDICAL EMPLOYMENT OF X-RAYS.

The case of Ellis *v.* Bridge & Co., Ltd., heard recently before Mr. Justice Bucknill and a special jury at the Hants Winter Assizes, forms interesting and instructive reading. The action was brought to recover damages for suffering and loss sustained through the alleged negligent application of X-rays. The plaintiff's case was that he suffered from locomotor ataxy, and was advised by Dr. Ord, of Bournemouth, to undergo treatment by X-rays. Dr. Ord further arranged that Mr. Keene, a member of a firm of chemists, should carry out this treatment. The rays were applied to the soles of the feet and to the abdomen for five minutes in each locality, on every second day, and it appears that there were 11 such sittings in all. The contention of the plaintiff was that the rays had been improperly applied, and that he was placed so close to the "bulb" that his feet touched the glass; also that Mr. Keene often left the room during the operation, and when he (the plaintiff) thus lay helpless there the sparks "often went into his feet." This took place in the latter part of December of the year before last, but early in January of last year the plaintiff found his feet so tender that he asked Dr. Ord to look at them, and it was found that the "soles had been deeply burnt, and in some places the tissues were quite destroyed." He was in great agony, and had morphia to allay the pain.

It was contended for the defence that the blame in the case rightly belonged to Dr. Ord, who prescribed the treatment and gave directions as to how it should be carried out. Mr. Bridge and Mr. Keene, partners in the defendant firm, stated that they advertised to undertake X-ray work for curative purposes, but only in connection with the medical profession. Mr. Keene stated that the tube was never nearer to the patient's feet than 12 in., and the treatment was carried out in strict accordance with Dr. Ord's instructions. He considered that it was Dr. Ord's place to see that the rays were properly administered. It was contended by Mr. Gardner and Mr. Coldwell, for the defence, that burning could not always be avoided even when not intended. Medical evidence was given both for and against the advisability of applying X-rays in such a case.

The Judge said the question was, What was the contract between Mr. Keene and Dr. Ord? The defendants were bound to use reasonable skill. If the jury thought that Mr. Keene had done what he was told to do, it would not be right to visit the defendant with damages.

The jury, returning into Court after a considerable interval, stated that there was no chance of their agreeing, and they were accordingly discharged.

If the above be a fair summary of the facts, it is not surprising that, in the face of such conflicting evidence, the jury failed to agree. Still, shorn of medical, legal and electrical subtleties, certain points in this case seem to stand out clearly enough. Probably few medical men would be in accord with Dr. Ord in regarding X-rays as a hopeful or even suitable form of treatment for the disease in question; nevertheless they would not deny him an undoubted right to his opinion (who can prove it wrong?), and holding the opinion it is only reasonable that he should act on it. But the arrangements made for carrying out the treatment may be seriously called in question.

Would it not have been better to have entrusted the matter to some brother-practitioner competent to deal with the technics as well as the therapeutics of the case, fully reckoning with the risks and not attempting to contract himself out of his responsibilities? The chemist in question may have been admittedly competent to handle the apparatus, but there presumably his knowledge ended. It was not his province to understand the nature of the vital structures he was dealing with, or their complex reactions to the energy he was employing. Indeed, the more the question is examined, the more it seems essential in the public interest that the medical employment of X-rays be entrusted only to medical practitioners.

Looking more critically into the disposition of the apparatus, and especially the all-important question of the distance of the X-ray tube from the patient's body, the only evidence given seems to be that of the two most interested parties, viz., the plaintiff and the defendant. Whilst the former states that the "bulb" was touching his feet, the

latter says that never on any occasion was it nearer than 12 inches.

Here we can only look for any inherent probability or improbability in one or other of the statements. It is quite certain that a burn *was* produced. The sparking (if it occurred) argues a certain propinquity of the tube, and radiographers may be surprised to learn that a burn may occur from a five minutes' exposure, on 11 alternate days, with the tube at 12 in. from the part.

Much as such "untoward incidents" are to be deplored, it is at least satisfactory to remember that an unintentional burn is now, with an experienced operator, almost a thing of the past. Sabourad's pastilles, the radiometer of Benoist, the illumination of the fluorescent screen, the measurement of the secondary current by the milliampere meter, and more perhaps than all, the accumulating experience of operators have contributed to this result. It is well within the bounds of probability that in the near future there may be found in a modification of one or other of the above methods, or in some form of oscillograph, or in the "X-ray electroscope," a means of measuring the exact output of an X-ray tube.

Until that happy time arrives, is it too much to hope that doctors (and chemists) will strictly apply to X-ray treatment the good old Hippocratic maxim that the first duty of the physician is "not to do harm?"

Electrical Wiring in America.

We are not so ready nowadays, as was the case some few years ago, to compare ourselves adversely with America in electrical matters generally. Probably at no time has the standard of electric wiring work in America even approached the standard of such work in this country. Loud, long, and bitter have been the complaints as to the stringent and diverse regulations with which the electrical contractor needs to conform; but, after all, these rules have had some influence in keeping up the standard of electrical installation work. Not that they are without rules in America. There is what is known as the National Code, adopted by the Board of Underwriters, and these rules, whilst perhaps not so stringent as some of those in existence in this country, would, if complied with, ensure generally a safe and satisfactory installation.

In the *Electrical World*, dated January 20th, there is an abstract of the report by the Electrical Inspector for the Indiana State Board of Underwriters; and, if the facts brought out in this report are any indication as to the average condition of wiring work in America, we should say that our trans-Atlantic cousins are at present miles behind us in this respect. Many installations were found which were the work of "men or boys equipped only with nippers and a screw-driver and a desire to become an electrician."

"I was dumbfounded," says the Inspector, "by the many hazardous conditions discovered, and often wonder how these faulty systems continue to distribute chained lightning to its appointed tasks with only an occasional outbreak on the part of the mysterious force."

Cases are cited where wood rosettes were strung like incendiary beads on a run of weather-proof wire, which was supported by being wound round iron gas piping. Pieces of flexible cord, having a capacity of 2 amperes, were in some cases used to carry about 33 amperes. In one establishment was found under the cashier's counter "a busy fire-spitting motor standing on a floor thick with grease and pieces of paper." As the Inspector says, "By all the rules of the game this store should have been burned out at least 10 times a day."

Another case mentioned in the report typifies a very common complaint all the world over where electrical motors are used. Some kind of fault existed in a motor or on the motor circuit, causing the fuse to blow. Instead of finding the fault and remedying it, the man in charge of the motor simply put in larger fuses until he got one big enough to stand the current. This saved him from any further annoyance, but the motor had its revenge by earthing one of the connecting wires to the frame, and the resulting sparks falling on an oily floor set the place on fire.

Another fire was caused by a home-made rheostat which was controlled by a rope passing over a window sash. The rheostat was constructed of small pieces of broom wire spliced together, the whole being mounted in direct contact with the frame partition.

It is obvious from the above note that the jerry wireman and contractor are not indigenous to this country, but both flourish in America also.

Another conclusion which might be drawn from the facts reported, is that electricity is scarcely so dangerous as it is sometimes made out to be; for, to take only the case of the store which the fire-spitting motor ought to have burned down ten times a day, the fact that no fire resulted at all is a somewhat ironical comment upon the rules referred to, and on some of our existing rules as to enclosed motors.

A "New" Type of Furnace.

One of our contemporaries announces that a prominent boiler manufacturing firm has now introduced as a *new* device an external grate for use with water-tube boilers. Nearly a column is given to a grave disquisition, illustrated by a line diagram, on the merits of high furnace temperatures, and the demerits of allowing unburnt gases to come in contact with the cooler surfaces of the water-tubes of the boiler. May we remind our contemporary that this is practically the identical type which Mr. W. H. Booth has advocated for years past, and whose possibilities have been repeatedly pointed out in our pages? The boiler makers in question ignored our suggestions for a long time. Perhaps, now that they have become converted, they do not care to remember the past. There is no need to preach to the converted, and possibly this is the reason why they refrained from sending us a communication embodying "new" information on the subject. Still, while we welcome their conversion, we did not expect to hear of it first from the pages of a contemporary.

Official Supervision of Installations in Germany.—The proposal of the German Home Office authorities to introduce a system of supervision over generating stations and installations in general has aroused a considerable amount of opposition on the part of the electrical associations and the branches of the Association of German Engineers. According to a report recently approved by the Westphalian branch of the Association of Engineers, the mining industry may be taken as representing the most dangerous trade for the use of electricity on account of the many unskilled workmen who are in the mines where the installations are at work, and also because the space underground is of a confined character and often very damp, and high pressure installations are more frequently employed there than in other trades. Notwithstanding the existence of these unfavourable conditions, it appears that out of a total of 859 fatalities which occurred in mines in 1899, only four deaths were caused by electricity. In 1900 the corresponding figures were 848 and 2, in 1901 956 and 2, and in 1902 818 and 4 respectively. The number of fatal accidents due to the use of electricity in mines is so insignificant as to render Government supervision entirely unnecessary. A further argument against State interference is put forward by the Association, apart from the burdens which supervision would place upon managers and the expense thrown upon owners of installations. It is that State supervision would render the electrical *personnel* less cautious and cause them to transfer confidence from themselves to the regulations of the Government.

CONDUIT WIRING FOR ELECTRIC INSTALLATIONS.

Last Tuesday evening the general monthly meeting of the London Section of the Electrical Contractors' Association (Incorporated) took place at Frascati's Restaurant, when Mr. L. M. Waterhouse read a paper, illustrated by lantern slides, on the above subject. Mr. E. L. Berry was in the chair, and there was quite a fair sprinkling of members, and of conduit manufacturers who had been specially invited.

Whilst there may not be anything particularly new to say about conduit wiring, there is plenty to say that is worth hearing; and perhaps nobody is more fitted to speak on the subject either on account of his experience or his facility for expounding it, than Mr. Waterhouse, the doyen of conduit manufacturers. In the days when Mr. Waterhouse first took up the question of elaborating a proper system of conduits and accessories, there were many changes, and progress was rapid. Then it was that furious discussions raged in these columns between the advocates of bare conduit and of insulating conduit. The champion of the latter was the late Mr. Fred Bathurst, who, before his death, recanted in favour of bare heavy gauge seamless conduit, and had only just commenced business in this direction when he died. This was the battle of the conduits; now a controversy is again taking place in these columns—curiously enough, between the protagonists of the original bare conduit and Mr. Bathurst's business successor. This may be called the battle of the standards. It was expected that Mr. Waterhouse would refer to this matter, and many were in hopes of seeing "the fur fly"; but almost at the outset he announced that, as a Committee was now sitting to consider the standardisation questions, the whole subject was *sub judice*, and he would omit the remarks he had included in his paper, and hoped others would keep off the subject. This request was loyally complied with.

After a few remarks of a historical nature, Mr. Waterhouse dismisses casing and lead-covering of wires as methods of protection which are not intended to survive, and arrives at two final systems of wiring—namely, the running of bare wires on insulators and of insulated wires in metallic conduits. The former, except for outdoor circuits and switchboard construction, is not practicable, whilst a combination of insulated wires on insulators as used on the Continent, however suitable for low voltage, can hardly be considered adequate for the high voltage supplies now obtaining in this country. Having thus "boiled down" the various systems to the metallic conduit ones, the author shows that light gauge socketed steel conduit used in connection with malleable fittings gave the first real impetus to the wiring business, owing to the lower prime cost of material and lower charge for wiring involved by its use.

(*To be continued.*)

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Generators with Auxiliary Poles.

In your issue of 16th inst., we notice in the article describing the plant at the Mansfield Electricity Works that you state, in describing a machine fitted with commutating poles, that this, you believe, is the first machine with auxiliary poles erected in a central station.

As this company were the pioneers of modern auxiliary poles (see our advertisements of 12 months ago), we should be glad if you would kindly insert this letter as a correction of the above statement.

We have pleasure in informing you that we have erected and set to work the following machines fitted with our "Phœnix-Pohl" patent auxiliary poles and ventilated field coils at the following central stations:—

Keighley, 300-kw. traction generator, running three months.

Burton-on-Trent, 100-kw. traction generator, running three months.

Sunderland Corporation, four sets of motor-generators, 300 kw. each, running three or four months.

We are at present erecting at the Gloucester Corporation Electricity Works a 600-kw. generator, and in addition to these we have sent out over 1,000 kw. of generators and several hundred h.p. of motors for other places than central stations. We have in hand at the present time generators aggregating over 2,000 kw. and motors of several hundred h.p. constructed under the above-mentioned patents.

Phœnix Dynamo Manufacturing Co., Ltd.
Herbert A. Jones, *Managing Director.*

Bradford, *February 17th*, 1906.

[We understand that the generator in question has been in service nearly three months, and was "running" in September last. It appears probable, however, that Messrs. Parker have supplied earlier machines of this type.—Eds. E.R.]

Expansion Joint Wanted.

A 3-in. steam pipe, with 140 lb. pressure, 40 ft. long, supplying a 35-h.p. steam engine working six hours daily, without any expansion joint on it, causes trouble owing to the joints leaking, due chiefly to contraction every day when steam is off. When a joint half-way along the pipes is opened, the flanges separate $1\frac{1}{4}$ in.

Can any maker supply an expansion joint that can be placed at the half-way joint, and that will not necessitate the pipes being cut?

Troubled.

How to Screw Conduits.

Judging from the most recent correspondence which we have been treated to on this subject, it seems to me fair to assume that my last letter must have been very disagreeable matter to Mr. Waterhouse and those of his disciples who have given him that loyal support of self-preservation which I previously referred to. Still, I welcome these further expressions of opinion, because I think, looked at from a liberal point of view, they go further to support my arguments than any previous contributions.

The mere fact that my arguments are met by contemptible suggestions and abuse generally is proof of the helplessness of some of your correspondents. I put to Mr. Waterhouse and others some *plain questions* by my last letter, which were, I think, deserving of equally plain answers. On the grounds of "common fairness," I propose dealing first with some of the statements made by Mr. Waterhouse. He states that "Armorduct" was originally *dumped* in this country from America. It is a preposterous statement!

My predecessor, Mr. Bathurst, who, as I think is generally admitted, and as I hope Mr. Waterhouse will admit, had some solid knowledge of conduit matters, originally went to America for his supplies of conduit, because he found it impossible at the time to manufacture in this country that high-class material which he considered essential for a good conduit system. Mr. Bathurst, as I am able to prove by data in my possession, contemplated from the very start the manufacture of Armorduct conduit in this country, and he was at the time of his untimely death seriously engaged in experiments in that direction. Since Mr. Waterhouse plainly states that I am now obtaining my supplies of Armorduct "from a gas-tube manufacturer in this country, &c.," I will give him and readers of the Electrical Review generally a plain answer by stating that Armorduct is now manufactured by the Armorduct Manufacturing Co., Ltd., at Warrington.

The American supplies of Armorduct were discontinued when my company decided to manufacture in this country, and that decision in turn was taken immediately the experiments which Mr. Fred Bathurst commenced, and which were continued by myself, had been carried to a commercially successful issue—when, in other words, my company found it possible to manufacture a material equal to the original American-made Armorduct tube. I have always looked upon, and I believe the trade in general have always looked upon, that American material as an article well in advance in

quality of the average British product. To speak of dumping, in view of the fact that Armorduct has always been a high-priced material, is little short of impertinence. Mr. Waterhouse was offered certain stocks which my company held at the time it severed its connection with the American producers of the tube, because my company were not prepared to pay a higher price for the material than that established by its own manufacturing cost. Still, Mr. Waterhouse did not buy that material—my company were the buyers. So much for the irrelevant part of the most recent contributions.

To return to the original subject, I contradict the statements which have been made that the thickness of gas tubes was originally settled upon for the convenience of welding; the present gauges of gas tubes are maintained because they are looked upon as essential for the purpose they cover. Mr. Waterhouse tells us that it is not practicable to thoroughly weld a tube of lighter gauge than gas barrel, and that the high welding temperature to which these tubes have to be brought unfits them in many ways for conduit wiring. If this is intended to be a condemnation of Armorduct, it must to a larger extent apply to Wireduct (no significance attaches to the similarity of the word Wireduct to the word Armorduct), since Wireduct is a light gauge, but welded tube with a lesser section of welding surface. Wireduct was originally introduced, I believe, to meet the competition of Armorduct (and here it is fair to state that when introduced it was dumped on the market at a price roughly 25 per cent. below the price of Armorduct); it was exhibited to the electrical trade as an ideal material from every point of view, and now Mr. Waterhouse tells us that it is unsuitable.

I am sorry to have ruffled Mr. Hill's feelings, but I must maintain that he has admitted a point which I made in the letter which started this controversy; I did not mean to lecture him or anyone else on the subject of manufacturing tubes, and I do not think any effort of that kind is traceable in my previous correspondence. I stated in my last letter that I would like to see the American conduit standard adopted in this country, because I conscientiously believe that standard to be the best existing at present. Mr. Hill's conduit experience is not, perhaps, sufficiently "early" to tell him that this country has taken its lead, at any rate, as regards screwed conduit, from America, and American practice is, I think, still well in front of British practice, and I, at least, am not beyond that country's lesson.

Mr. Hill applies certain remarks which I made regarding solid-drawn conduit to his firm—I never intended that he should, and since he assures us that his company supplies seamless conduit tubes of a quality which would satisfy the Admiralty and the Board of Trade specifications for the highest class of boiler tubes, I am open to admit that he is giving his customers quite exceptional value. Seamless steel conduit tubes are, to my positive knowledge, frequently manufactured from scrap material and rejected boiler tubes, and I maintain that tubes of that description are unfit for conduit purposes, and I further maintain that seamless tubes of a reliable quality are to-day not manufactured at anywhere near the price of the best welded tubes, and I state without fear of contradiction that tubes of a gauge similar to that of my company's product can be perfectly welded, and further state that they are as good for conduit purposes as any seamless tubes manufactured.

To return to standardisation: I would like to repeat that I look upon bedstead tube sizes as bastard sizes for engineering purposes, and upon the fine threads commonly used to-day with conduit tubes as bastard threads, whole and sundry. It is these bastard sizes and bastard threads I am anxious to dispose of, and I wish to repeat that it would mean a very important change to my own company.

A few of the questions contained in my last letter on which I would like to be met by fair and square arguments are:—

1. Are tubes of bastard sizes screwed with bastard threads desirable for wiring purposes? If so—why?

2. Can any sound explanation be given for their introduction beyond the fact that Mr. Waterhouse originally obtained (and I believe he still obtains) his supply of tubes from a firm of bedstead tube makers?

3. Why, if bastard sizes and bastard threads are desirable, is an overwhelming majority of the electrical trade to-day in favour of gas sizes and gas threads?

4. Why, if bastard sizes and bastard threads have been found so satisfactory as Mr. Waterhouse would have us believe, have the majority of recent Government and municipal specifications, and the specifications of the leading consulting engineers, asked for tubes of gas sizes of a sufficiently heavy gauge to screw standard gas?

Since conduit manufacturers have now made a first effort in the direction of standardisation, it may be preferable to abandon this controversy; but if it is to be continued, I hope plain answers will be given to plain questions, and I hope legitimate arguments will not meet with irrelevancies and general abuse.

W. Schmahl,

Managing Director, the Armorduct Mfg. Co., Ltd.

London, *February 20th*, 1906.

Thermal Efficiencies.

I have again to bring back one of your writers, Mr. J. B. C. Kershaw, to the point at issue: is 85 per cent. efficiency possible with a combination steam generating plant of the latest design?

With regard to the question of the accuracy of the "Darling" calorimeter, as used by my firm, I may say that we have repeatedly had our samples checked in conjunction with such eminent authorities as the Victoria University, of Manchester, the City of Sheffield, Leeds, and other similar places, and the differences between the results obtained have only been those due to possible errors of observation so small as to be negligible. We may, therefore, we consider, rely upon the results given by our calorimeter as much as Mr. Kershaw can rely on his own.

Alfred W. Bennis, M.I.Mech.E.

Bolton, *February 20th*, 1906.

Electric Lifts.

In Mr. Spence's first letter he started out quite in the manner of a prophet with a new gospel to preach, a man who had not neglected to make full use of his "gray matter," and who in the full consciousness of that fact was desirous of teaching the "first-class lift builders" how to avoid the "deplorable" results which they have hitherto produced.

It surely was natural to suppose that our mentor imagined he had discovered something new.

But we are now assured that this was all a mistake, he was only referring to the work of "the Sprague people" who "were there before" him. Well, yes, quite 10 years before.

One is bound to speak with some reserve as to the work of other inquirers in any field, as only portions of the results are published, but, subject to correction, we believe Mr. Sprague's chief discovery was that his very ingenious devices for getting high efficiency out of worm gears did not produce a satisfactory lift. Certain it is that no one has been induced to follow him, and the Sprague machines which have found their way into this country are of the usual self-sustaining type.

Mr. Spence proceeds to misquote a reference we made to brakes, and in doing so comes nearer to the truth than he imagines. Let us put our statement in different words. The most perfect brake yet made is a notoriously unreliable and variable appliance if used as Mr. Spence advocates, and will assuredly sooner or later lead to disaster. On the other hand, a much less perfect brake is quite adequate on one of the "deplorable" machines usually manufactured.

Mr. Spence says an electro-magnetic release brake is neither unreliable nor variable. He probably means that, so far, he has not found them to be so, but a wider experience will, no doubt, reduce his confidence. Really, he contradicts, by implication, his own dictum within the same paragraph, wherein he describes how the brake has the way smoothed for it by strengthening the field to slow down, and then by returning current to the line. Here we have the admission, after all, that the brake alone

is insufficient, and instead of supplementing it by the simple and *ever ready* device of the self-sustaining gear, changes in the field strength and the resistance of the line are to be relied upon.

But suppose a fuse blows, and the field collapses, and the machine is cut off from the line, what is then to help the brake ?

Suppose, again, that, owing to one of those numerous surprises which remove monotony from the electrical engineer's life, the current is withdrawn from the line. All the magnets will be left in parallel with the motor, and as they will be in the closed position, very little current will suffice to keep them there. Under these conditions the lift would drive the motor, and this would generate quite sufficient current to keep the brake magnet energised, and to hold the brake off. Nothing but a switch placed between the armature and the magnet system, and operated by hand, would save the machine.

Mr. Spence's scheme is a beautiful one so long as everything works exactly as designed, but he has overlooked the fact that as a result of long and careful watching of actual practical contingencies, experienced lift builders have evolved a type of machine which will come safely through, even if a number of sections of its organism fail in their duty ; and, to come from the general to the particular, a special effort by the designers of the "deplorable" machine has been made to ensure that failure of any part or function should produce stoppage, and not conduce to running away.

Mr. Spence's statement as to the limit of increasing momentum in high efficiency machines would not be correct in either of the very ordinary contingencies we have described ; but with a self-sustaining gear, a decreasing momentum would be brought about.

In lift work it is the emergency condition which must be provided for, and not merely the normal.

One portion of our critic's letter possesses humour of the unconscious order. He is moved to remark that we joined in this discussion before he had even mentioned us. We are sorry to have so transgressed, but do not remember that anyone had "mentioned" Mr. Spence before he burst upon us with his discussion upon our neglect of our admittedly small modicum of "gray matter," and the "deplorable" consequences.

A. Smith & Stevens.

London, *February 19th*, 1906.

There appears to be some necessity for reference to Mr. Spence's letter of the 13th, otherwise I would not trespass further on your valuable space.

First, let me apologise for having used an expression that has shocked his feelings. The piety of that chaste and sober race, of which he is one of the few left north of the Solway, is well known to me, and the use of an expression so foreign to their ideas of propriety and so likely to raise hopes hardly probable of realisation was unpardonable.

The reference Mr. Spence called to my attention is unfortunately useless, as it does not give particulars, and the original article is not within my reach at the moment. If Mr. Spence takes all his data when given in this form, I am afraid his credulity exceeds mine. However, as I have had a worm gear which had an efficiency of 90 per cent., I can concede this point ; but even Mr. Spence has doubts as to the 93 per cent. for a double reduction gear, which I question, claiming only 90 per cent., which is also unusual *except* in class-rooms and laboratories, which called forth so much of Mr. Spence's indignation.

We appear to differ more on the question of motor efficiency. I gave 70 per cent. as a fair figure for an 8-H.P. motor working at about 6 H.P. I think this is nearer the average than 79 per cent., which savours of the laboratory, but which, of course, can easily be obtained if it is specially required and the price is not a consideration.

The efficiencies I gave originally were gear efficiencies, and I think my assumption of 70 per cent. for both motors a fair one.

Finally, had Mr. Spence not "presumed" that I was associated with a firm of lift makers, with the consequent innuendo that my article was not an attempt to add to public information, but a mere trade puff, the references to my position would have been unnecessary. He has still to learn what that is, but as there is no public interest involved, I prefer to carry the point no further. He confesses he has "learnt his lesson"—another mistake.

Percy Good.

Faraday House, *February 20th*, 1906.

P.S.—Mr. Spence flatters me with his reference to my "holy hands" and "naughty words." As an engineer, the reputation of my hands is hardly saintly.

The Single-Phase Induction Motor.

Judging by the very interesting article by Mr. V. A. Fynn in the current number of the ELECTRICAL REVIEW, he has succeeded in developing a form of variable speed motor, I presume, by the use of suitably connected auxiliary coils along the axis D D. Although the E.M.F., E R, is invariable at a given speed, depending only on the transformer flux and the turns on the rotor, yet the current and flux it is able to produce depend entirely on the arrangement of these auxiliary coils. Clearly, to vary the speed we must vary this flux.

Having been experimenting along somewhat similar lines, I should like to place upon record the fact that I tried such a machine, though it was not a commercial success, in the works of the Rhodes Electric Manufacturing Co., Ltd., at Bradford, in July, 1905. The machine was a six-polar, operating at 50 periods, yet the normal speed was 600, instead of rather less than 1,000 r.p.m., as one would expect in an induction motor.

By the adoption of suitable means, the speed could be raised to 1,100.

However, the machine was not an entire success, owing to some features in its construction which I did not at the time see my way to alter, so it was temporarily abandoned in the hope that the same result would be attained later on, in a different manner.

All those who have made a study of the single-phase commutator motor must recognise the theoretical possibility of a variable speed shunt motor ; but all must congratulate Mr. Fynn on being the first to reduce this possibility to practice.

Apart, however, from the question of variable speed, I cannot quite agree with Mr. Fynn, that a diagram is unnecessary to elucidate his theory. I think such a diagram would make it more clear that the action of the motor depends on the current being approximately in phase with the E.M.F., E.T.—E.B. In fact, in a motor absolutely devoid of resistance, the working current would lag 90° behind the E.M.F., E B, and there would be no output. I should also be glad if Mr. Fynn would show, according to his theory, why the no-load current is twice the magnetising current. I have found it rather difficult to give a simple demonstration of this fact, except by using the theory of a rotary field.

F. Creedy.

Bradford, *February 19th*, 1906.

Overhead Construction.

In connection with Mr. Tweedy's contribution on "Overhead Construction" in your issue of October 20th, 1905, there are statements contained therein with which most people will agree ; but there are others which I consider are open to criticism.

In connection with the rake of the poles, it has been found in Sydney, on an ordinary 42 ft. roadway between kerbs, that in soil or clayey ground a 6-in. rake is ample for span poles with a strain on the span wire with the trolley wire attached of 700 lb. or 800 lb. applied at a height of 21 ft. from the ground line. This will leave a rake on the pole of about 1½ in. to 2 in. after allowing about 1 in. for the give in the ground. The poles referred to have between 4 in. and 5 in. of concrete placed round them to the full depth of 6 ft. In soft or made ground, of course, it becomes a matter of judgment as to how much rake to allow for the various strains.

With reference to Mr. Tweedy's remarks as to the bases on steel poles, and his statement that lead is a dangerous metal to use for caulking, no trouble has been experienced

on the Sydney system from lead-caulked joints. It is difficult to see how any galvanic action can take place, unless there are occasional interstices between the lead and the steel which will allow moisture to accumulate and set up this action. If the lead is poured in thoroughly and then treated with a caulking tool, no moisture will get a lodgment between the lead and the pole, and if thoroughly painted no action should take place. On the other hand, rust joints have given trouble through excessive oxidation, which sets up enormous stresses in the base, and has in a number of cases actually split the cast-iron base, leaving a crack of from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. in width, and as the rust joint continues to oxidise, the crack eventually becomes larger, and would, if allowed to continue, ultimately ruin the base.

With reference to the poles made in sections, Mr. Tweedy states that the effect of the rain trapped by the ledge caused pitting. This difficulty is easily overcome by forming a water-shed of putty at the junction of the two sections. The pitting protects the putty from the effects of the sun, and it has been found that it does not crack and peel off.

The statement that "primarily bases are intended to protect the poles from errant vehicles and mutually to protect the vehicles, but that reason has ceased to exist with poles made of steel and planted on the footpath," does not cover all the work that the bases are required to do. Their chief value, to my mind, lies in their protecting the butts of the poles from the corrosive effect of dogs' urine, which is about the best solution obtainable for creating rust on steel. I have confirmed this in a number of instances where it is known that dogs congregate, such as street corners, where the steel poles have been affected to a much greater extent than in positions between the cross streets. One very effective method of overcoming trouble of this nature is to wrap a pure zinc sheath, 20 gauge, about 18 in. in length, very tightly round the pole, the zinc and the pole having been previously treated with a thick coat of white lead and oil. When erected, this sheath should be about 3 in. below the surface of the concrete and 15 in. above the ground, and the concrete carefully coned up round the pole so as to form a water shed. The cost of these sheaths, with labour and material, should not be more than 2s. 6d. per pole. It also has the advantage of allowing the pole to be painted right to the ground line, this being impossible if the butt of the pole has been treated with a bituminous or tarry composition. The sheath is scarcely visible, whereas a cast-iron collar filled with bitumen or other composition would detract considerably from the appearance of the pole.

With reference to the water getting into the foot of the steel poles, I think this is generally caused through the upward filtration of the water after heavy rain, or where the pole has been erected in naturally damp ground, and not on account of the finial having been left off. "The cure for this," Mr. Tweedy states, "is to be obtained by draining the pole"; but he does not state how this can be done when the bottoms of the poles are 6 ft. below the roadway. His suggestion to fill the whole pole with concrete, after treating the interior with paint or other preservative, is an expensive method, and would certainly not add considerably to the strength of the pole, as a column of concrete 7 or 8 in. in diameter and 25 ft. high would be of very little strength when the strain was applied at the top.

I quite agree with Mr. Tweedy's objections to anchoring at curves and every $\frac{1}{4}$ mile. The anchoring at curves is particularly objectionable, as when the trolley wheel becomes de-wired in traversing the curve, as it occasionally will, due to stiff trolley base or bad trolley wheel, the anchor wire frequently forms a trap for the trolley pole. Curves are sufficiently anchored by the pull-off wires in each direction. I consider it advisable to anchor on each side of section insulators in order to take the strain off the insulator. The anchoring for protection from the effect of the trolley wires breaking can best be effected by allowing the wire to rest on the span, and insulated from the trolley wire by a ball-strain insulator on each side of the span wire. There is no occasion to have any strain on the anchoring wire (or "preventer wire," as it was called), as directly the trolley wire breaks the anchoring wire takes up the strain.

With regard to the quotations from the remarks of a lineman named Dudgeon, I do not consider that the arcing is caused through the insufficient contact with the trolley wheel, but by the trolley wheel jumping from the ear back on to the trolley wire at the trailing end and so causing a temporary disconnection of the circuit. It will be noticed that this pitting only takes place at the trailing end of the ear.

Mr. Tweedy's remark that "figure-8 trolley wire would be the salvation of many a line in England" is not, I think, warranted, as my experience shows that where there is fast travelling—especially on down-grades—a considerable hammering action takes place at the ears, which become worse and worse as time goes on. This is for speeds of between 20 and 30 miles an hour; but for slow speeds up to 8 or 10 miles an hour, "figure-8" trolley wire is very suitable, and is more easily maintained. In addition to the hammering action on the trolley wire at the trailing end of the ear, a peculiar waving action takes place for a length of from 12 in. to 15 in. under the ear, and it has been found necessary, in order to obviate this trouble, to erect ears which completely envelop the wire, transferring action of this nature on to the ear, and removing it from the wire.

Mr. Tweedy refers to Mr. Sayers's method of connecting feed wires to the trolley wire by cutting a hole in the pole 4 in. × 5 in., 1 ft. below the ground level. It appears to me that, in order to do this, the pole would be considerably weakened in the most important section. Why not erect a separate pipe 2 in. in diameter from the section pillar and attach it to the pole? Its appearance is not objectionable, and the freedom from difficulties in bending the cable through an arc of small radius, and from the liability for moisture to accumulate at the foot of the pole, would more than counterbalance any unsightliness.

R. D. D.

Sydney, *January 8th*, 1906.

LEGAL.

Action Against the National Telephone Co.

In the Chancery Division on Friday, before Mr. Justice Kekewich, Mr. Stewart Smith, K.C., said that in the case of Taylor *v.* The National Telephone Co., he had a motion to restrain the National Telephone Co. from erecting a building in Paddington in such a way as to obstruct the light coming to the plaintiff's windows. Mr. Stewart Smith said the exchange was still working, but it was the proposed position of the new exchange that was objected to. It was proposed to put up the new building 49 ft. high at a distance of 32 ft. from plaintiff's window. Plaintiff used his premises as offices, and it was, therefore, very material that the light should not be affected. Mr. P. O. Lawrence, K.C., who appeared for the defendant company, said he had not yet any evidence, and it was arranged that the motion should stand over.

Rex *v.* Frank.

On Saturday at the Middlesex Sessions, Peter Frank, otherwise Laxton, 32, engineer, came up for sentence, having pleaded guilty at the previous Sessions to obtaining by false pretences a dynamo and a field regulator from Maurice Walter Woods, electrical engineer, of Avenue Works, Park Road, Acton; and a cutting machine from Robert A. Pott, of Manchester. Mr. Woods supplied the field regulator, and then the dynamo, to the order of Frank, and went to his premises at Sprowston Lane, Forest Gate, and found them very different to what he had expected from his stationery. On the door was "Peter Frank, scale maker," on a label. He obtained police assistance, and found the landlord of the premises, who said he let the premises to one Melhuish, who sub-let to Frank. When Detective-Sergeant Merch arrested prisoner, he said his name was Laxton, and he bought the cutting machine from Frank to whom he sub-let the premises at Sprowston Lane. He had traded in the name of Melhuish as a coil maker. It was his wife's maiden name, and they traded together in that business. Mr. M. Sharpe sentenced prisoner to 12 months' hard labour.

Godfrey *v.* Bromley Corporation.

At Bromley (Kent) County Court on February 16th, Herbert Jas. Godfrey, electrical engineer, 188, High Road, Balham, S.W., sued the Corporation of Bromley for £15 8s., balance of account alleged to be due in respect of installing the electric light at the refuse destructor works. It appeared that the plaintiff secured the contract for the installation at £634 6s., and on his behalf it was stated that during the progress of the work certain extras were ordered and carried out, at a cost of £15 8s. For the defence it was submitted that what the plaintiff claimed were not extras, but came within the terms of the contract. Judge Emden found for the Corporation, with costs.

MORPHEW *v.* ELECTRICAL CORPORATION, LTD.
(ELECTRICAL FITTINGS DESIGNS.)

IN the City of London Court on Monday, before his Honour Judge Lumley Smith, K.C., a claim was made by Mr. Reginald Morphew, designer and architect, 10, New Square, Lincoln's Inn Fields, against the Electrical Corporation, Ltd., 69, Aldersgate Street, E.C., to recover £100 for making designs for them for electrical fittings. Mr. Harold Morris appeared for the plaintiff, and Mr. C. Herbert Smith for the defendants. It seemed that the plaintiff had designed some chambers in the West End, where the electrical fittings, in which he was a specialist, were much admired by Mr. Bower, one of the defendant company's directors. He suggested that the plaintiff should make designs for electrical heaters and other fittings. Plaintiff was to make designs at first for heaters, and to be paid a royalty of 2½ per cent. for the first two years, and then 5 per cent. on whatever money defendants obtained from the sale of the goods made from plaintiff's design. Then in June an agreement was made that plaintiff should design some electrical fittings. Plaintiff was at first willing to be paid royalties, but defendants would not bind themselves not to employ other designers, although he was willing to work for them exclusively. In all he had supplied 93 different designs, and those had all been returned because defendants would not be bound not to go to other designers. Plaintiff now demanded payment for his services. Defendants said they were willing to pay plaintiff the royalties that might be found due when an account was taken. They had made up goods from plaintiff's designs, and they found that they were not going as rapidly as both could have hoped. Now that plaintiff found that he would not get much out of the agreement made, he wanted to get out of it, and have damages for breaking a contract which had never existed. Defendants never agreed to take all plaintiff's work and pay down for it.

Judge LUMLEY SMITH said there was no evidence that plaintiff had suffered any damage, and he must find for the defendant company with costs.

BUSINESS NOTES.

Electromobiles in the United States.—The Association of Electrical Vehicle Manufacturers is the name of a new body which has just been formed at Albany, N.Y, "to foster trade in electrical motor vehicles, reform abuses in business, and to promote harmony among the trade."

George Hill & Co.—At the Lancashire Chancery Court last week Mr. Cunliffe moved that the appointment made by the Court on January 2nd of Mr. Hermann Möller, chartered accountant, to manage the business formerly carried on by Mr. George Hill, deceased, as an electrical engineer, under the name of "George Hill & Co," at 347 and 349, Chester Road, should be continued until trial of the administration action. Mr. Abbott, for the respondent, consented subject to security being given to the satisfaction of the Registrar.

The A.E.G. and Ganz & Co.—It is stated that difficulties have arisen in connection with the scheme, to which reference was made in these columns a few months ago, which aims at the establishment of a community of interests between the Allgemeine Elektricitäts Gesellschaft, of Berlin, and the Buda-Pesth firm of Ganz and Co. As will be remembered, the former company has maintained for a period of about two years intimate relations with the General Electric Co., of the United States, whereby an interchange of inventions and experience takes place between the two companies. It has transpired during the recent negotiations that Messrs. Ganz & Co. have a number of business relations which, it is said, do not quite fit in with the interest spheres of the A.E.G., as represented by its connection with the New York company. For instance, the Buda-Pesth firm have sold patents to an American company—not the Westinghouse Co.—and have thereby become placed in relations with it which are asserted to be in a certain amount of opposition to the A.E.G., as also are other agreements made by the Hungarian company. Negotiations are, however, being continued between Berlin and Buda-pesth in the hope of the complete removal of all these difficulties, or the conclusion of a compromise, but it is at present impossible to say what the ultimate result will be.

Electric Cranes.—MESSRS. ROYCE, LTD., of Manchester, have just received an order from Messrs. Ruston, Proctor and Co., Ltd., of Lincoln, for four 3-motor electrically-driven overhead travelling cranes, for use in the new gas engine department.

A Rio de Janeiro Contract for the U.S.A.—An evening contemporary says that an order has been placed in the United States "for hydro-electric plant of 100,000 H.P. for the Rio de Janeiro Tramway and Light Power Co. The order is valued at upwards of £5,000,000."

Consular Notes.—BRAZIL.—According to a report of the Austrian Consul at Rio de Janeiro, the general agency in Brazil of the Siemens & Halske Aktiengesellschaft, of Berlin, which has acted as representative of the two firms, Siemens & Halske and Schuckert Werke since their amalgamation, has now been formed into a company with the title, "Companhia Braziliera de Electricidade Siemens-Schuckert-Werke. The director is Engineer Gustav Liechtenberger, and the company will also act as agents for the Gesellschaft für Drahtlose Telegraphie.

SPAIN.—The German Consul at Madrid reports that the laying of a new cable is proposed by the Spanish Government between Cadiz and Santa Cruz de Tenerife (Canary Islands). According to the law authorising this work, the Government may either undertake the construction and exploitation of the cable or grant a concession for the work to some person or firm for a stated period. It is also proposed to establish communication by wireless telegraphy. Some seven months ago direct communication between Spain and Santa Cruz was stopped, and since then telegrams have had to be sent *viâ* the Brest-Dakar route, which has entailed greater expense. Consequently, the new cable will be of great advantage.

CHILE.—The German Consul at Valparaiso reports that the Compania Comercial in Concepcion have received a concession for a telegraph service between Concepcion and Nueva Imperial (province of Cautin).

CANARY ISLANDS.—The Austrian Consul at Madrid reports that tenders are being called for the construction and exploitation of a telephone service in Aruca (Canary Islands). The maximum duration of the concession is 20 years, and the concessionaire must pay to the Government 10 per cent. of the total receipts. The installation must be completed within 120 days of the signing of the contract.

RUSSIA.—The Austrian Consul at Kiev reports that by the authority of the town magistrate, under whose auspices the exhibition was to have been held, it has been decided to postpone the International Electro-Technical Exhibition at Kiev, which was fixed for the spring of this year.

Parliamentary.—The Examiners of Standing Order Proofs to the House of Commons sat again on Thursday last week (February 15th), when it was found that the following measures did not comply with Standing Orders:—London County Council (Tramways and Improvements) Bill; the Romford and District Tramways Bill; and the London United Tramways Bill.

METROPOLITAN PNEUMATIC DISPATCH BILL.—At the meeting of the Metropolitan Water Board on Friday last, the Law and Parliamentary Committee reported that an intimation had been received from the promoters' agent intimating that the Metropolitan Pneumatic Dispatch Bill would not be further proceeded with. The petition which the Board was to have presented against the Bill would not therefore be lodged.

PETITIONS AGAINST BILLS.—A large number of petitions have now been deposited in the Private Bill Office in Westminster Hall. Among the petitions against the principal Electricity Bills are the following:—

Against the Additional Electrical Power Supply (London) Bill:—Petitioners: North London Railway Co.; Great Northern Railway Co.; Stepney Borough Council; Whitechapel and Bow Railway Co.; Westminster Electric Supply Corporation; Regent's Canal and Dock Co.; London County Council; Croydon Corporation; South Met. Gas Co.; Great Eastern Railway Co.; Great Central and other Railway Companies; Corporation of London; South Suburban Gas Co.; London Electric Supply Corporation; Kensington and Knightsbridge Electric Lighting Co. and Notting Hill Electric Lighting Co.; London Hydraulic Power Co.; Charing Cross, West End and City Electricity Supply Co.; Met. Water Board; Promoters of Administrative County of London and District Electric Power Bill; North Metropolitan Electric Power Supply; and a large number of Borough and other Councils.

Against the Administrative County of London and District Electric Power Bill.—Petitioners: City of London Electric Lighting Co.; Conservators of the River Thames; Westminster City Council; Westminster Electric Supply Corporation; London County Council; Kent Electric Power Co., and the Kent Electric Power Syndicate; Corporation of London; Central Electric Supply Co.; St. James' and Pall Mall Electric Light Co.; London Electric Supply Corporation; Kensington and Knightsbridge Electric Lighting Co., and Notting Hill Electric Lighting Co.; London Hydraulic Power Co.; South London Electric Supply Corporation; Charing Cross, West End and City Electricity Supply Co.; London, Tilbury and Southend Railway Co.; South Metropolitan Gas Co.; Gas, Light and Coke Co.; South Metropolitan Electric Light and Power Co.; Metropolitan Water Board; Promoters of the Additional Electrical Power Supply (London) Bill; and a large number of Borough and other Councils.

Against the Baker Street and Waterloo Railway Co.'s Bill.—Petitioners: Grand Junction Canal Co.; London County Council; Great Western Railway Co.; Metropolitan Railway Co.; and St. Marylebone Borough Council.

Against the Charing Cross, West End and City Electricity Supply Bill.—Petitioners: Whitechapel and Bow Railway Co.; Westminster Electric Supply Corporation; London County Council; Brompton and Kensington Electricity Supply Co., Ltd.; Great Central and "other railway companies"; Kensington and Knightsbridge Electric Lighting Co., and Notting Hill Electric Lighting Co.; London Hydraulic Power Co.; St. James' and Pall Mall Electric Light Co.; Central Electric Supply Co.; County of London Electric Supply Co.; Promoters of Administrative County Electric Power Bill; North Metropolitan Electric Power Supply Co.; Central London Railway; Metropolitan Electric Supply Co.; and a number of Borough and other Councils.

Against the City of London Electric Lighting Bill.—Petitioners: London County Council; Westminster Electric Supply Corporation; Great Central "and other railways"; Corporation of London; Metropolitan Water Board; Promoters of Administrative County Bill; and several Borough Councils.

Against the Hammersmith, City and North-East London Railway Bill.—Petitioners: The Duke of Norfolk; City of London Electric Lighting Co.; Great Eastern Railway Co.; Thames Conservators; Westminster City Council; London County Council; Duke of Northumberland; Westminster Electric Supply Corporation;

Great Western Railway Co. and Metropolitan Railway Co.; Great Western Railway Co. and London and North-Western Railway Co.; Great Northern Railway Co.; London, Brighton and South Coast Railway Co.; North-East London Railway Co.; Metropolitan District Railway Co.; Kensington and Knightsbridge Electric Lighting Co.; Waterloo and City Railway Co.; Central London Railway Co.; Baker Street and Waterloo Railway Co.; Charing Cross, Euston and Hampstead Railway Co.; Great Northern, Piccadilly and Brompton Railway Co; London United Tramways (1901), Ltd.; and a large number of Borough and other Councils.

Against the London County Council (Electric Supply) Bill.—Petitioners: Westminster Electric Supply Corporation; Kent Electric Power Co.; and the Kent Electric Power Syndicate; "Great Central" and other railway companies"; London Electric Supply Corporation; South London Electric Supply Corporation; Charing Cross, West End and City Electricity Supply Co.; South Metropolitan Electric Light and Power Co.; Companies Supplying Electrical Energy in the Administrative County of London; Promoters of Administrative County Bill; Central London Railway Co.; Metropolitan Electric Supply Co.; Promoters of the Additional Electrical Power Supply (London) Bill, and a number of Borough and other Councils.

Against the London Electric Supply Corporation.—Petitioners: London County Council; Westminster Electric Supply Corporation; Kensington and Knightsbridge and Notting Hill Electric Lighting Companies; Great Eastern "and other railway companies"; South London Electric Supply Corporation; Metropolitan Electric Supply Co.; Central Electric Supply Co.; St. James' and Pall Mall Electric Light Co.; Promoters of Administrative County of London and District Electric Power Bill; Central London Railway Co.; South Metropolitan Electric Light and Power Co.; and a number of Borough and other Councils.

Against the Metropolitan Electric Supply Bill.—Petitioners: The London County Council and several Borough Councils.

Against the North-West London Railway Bill.—Petitioners: Promoters of Hammersmith, City and North-East London Railway Bill; London and North-Western Railway Co.; Westminster City Council; London County Council; Metropolitan Railway Co.; and several Borough and other Councils.

Against the South Metropolitan Electric Light and Power Bill.—Petitioners: Kensington and Knightsbridge and Notting Hill Electric Lighting Companies; London Electric Supply Corporation; St. James' and Pall Mall Electric Light Co.; Central Electric Supply Co.; Promoters of Administrative County Bill; Central London Railway Co.; and several Borough Councils.

Against the West London Electric Undertakers' Association.—Petitioners: Brompton and Kensington Electricity Supply Co., Ltd., and the Chelsea Electricity Supply Co.; Promoters of Administrative County of London and District Electric Power Bill; Metropolitan Electric Supply Co.; Westminster City Council and London County Council, and several Borough Councils.

The following petitions against Bills originating in the House of Lords have been deposited in the Private Bill Office:—

Against the Folkestone, Sandgate and Hythe Tramways (No. 1) Bill.—Petitioners: Kent Electric Power Co.; South-Eastern Railway Co. and the Managing Committee; National Telephone Co.; (No. 2 Bill) South-Eastern Railway Co. and Managing Committee, and National Telephone Co.

Against the Kent Collieries Electricity Supply Bill; Kent Electric Power Co.; companies supplying electrical energy in the Administrative County of London; Folkestone Electricity Supply Co.; Westminster Electric Supply Corporation; National Telephone Co.

Against the Newcastle-upon-Tyne Electric Supply Bill.—Petitioners: Tynemouth Corporation; Tynemouth Gas Co.

Against the Shropshire, Worcestershire and Staffordshire Electric Power Bill.—Petitioners: Great Western Railway Co., and a number of local authorities.

Against the West Cumberland Electric Tramways Bill.—Petitioners: Maryport U.D.C. and Cleator Moor U.D.C.

Against the West Yorkshire Tramways Bill.—Petitioners: Halifax Corporation; Bradford Corporation.

The Examiners of Standing Order Proofs to the House of Commons sat again on Tuesday for the purpose of considering a further number of Standing Order proofs. The following unopposed Bills were found to comply with Standing Orders:—Macclesfield and District Tramways; Preston, Chorley and Horwich Tramways; Buenos Ayres Grand National Tramways Co. Non-compliance was found in the case of the Middlesex County Council (Tramways) Bill, and the following Bills were postponed until March 1st:—Folkestone, Sandgate and Hythe Tramways (Nos. 1 and 2), and Mid-Derbyshire Railway.

To Tyneside.—A Sheffield paper says that the Castner-Kellner Alkali Co., Ltd., of Runcorn, have, after careful investigation, decided to transfer their works to Tyneside, owing chiefly to the fact that on the banks of this river there is a good supply of cheap electricity available. A suitable site has been secured at Wallsend in close proximity to the large power station there, and the work of laying down the necessary plant will shortly be commenced. The old Newcastle firm of Locke, Blackett & Co., Ltd., have decided to introduce at their lead works a new process for refining lead by an electrolytic method.

Bankruptcy Proceedings.—C. V. T. De Falbe (Electical and General Contracting Co.), electrical engineer, 17, Shaftesbury Avenue.—A first dividend of 1s. in the £ is payable on February 28th at the offices of Poppleton & Appleby, 3, Barbican, E.C. (An amended notice to this effect appeared in the *London Gazette* for February 20th.)

G. W. G. Booker.—At Birmingham Bankruptcy Court on February 15th, Geo. Warsop Griffiths Booker, formerly carrying on business at Regent Parade and Vyse Street, Birmingham, in partnership with Stewart Frank Haywood Farmer, Chas. Haywood Farmer and Alfred Henry Newey, under the style of "Alfred Newey," as electrical fittings manufacturer, applied for his discharge from bankruptcy. The liabilities were £1,528, and the assets only realised £5 odd, insufficient to pay the bankruptcy charges. The discharge was granted on debtor paying £100 by instalments.

Albert John Harris.—At Bradford County Court on February 14th, application was made for the discharge from bankruptcy of Albert John Harris, electrical engineer, of the Borough Mills, Bradford. There was no opposition, and it was stated that the assets greatly exceeded the liabilities. An immediate discharge was granted.

Messrs. A. Parker & Co., electrical engineers and contractors, Upper Richmond Road, East Sheen.—Receiving order made on February 13th at Wandsworth Court, on petition of a creditor.

Dissolutions and Liquidations. — The Electric Works Co., Ltd.—This company is winding up voluntarily, with Mr. D. L. Chalmers, 12, St. John's Lane, Liverpool, as liquidator.

Taunton and West Somerset Electric Railways and Tramways Co., Ltd.—This company is winding up voluntarily, with Mr. P. N. Gray as liquidator. Mr. Gray is authorised to enter into an agreement with the Taunton Electric Traction Co., Ltd.

Nernst Electric Light, Ltd.—Creditors are to send particulars of debts, &c., to the liquidator, (Mr. M. Levinger, 5, London Wall Buildings, E.C.) by March 15th.

Pioneer Electric Co., Ltd.—A meeting will be held at 66, Victoria Street, S.W., on March 24th, to hear an account of the winding up from the liquidators, Messrs. J. F. Albright and R. Dand.

Messrs. E. E. Edwards & E. G. Stockwell, lately trading as Messrs. Edwards, Stockwell & Co., electrical engineers and contractors, of 133, Fenchurch Street, E.C., have dissolved partnership. Mr. Edwards is continuing the business, which will be conducted as hitherto, and he will attend to all financial matters of the late partnership.

The Everyday Electricity Publishing Co., Ltd.—Creditors must send particulars of their debts, &c., to the liquidator, Mr. H. L. Price, 15, Fountain Street, Manchester, by March 3rd. A meeting is to be held at that address on March 16th to hear an account of the winding up.

Catalogues and Lists.—Messrs. Crompton & Co., Ltd., Salisbury House, E.C.—New pamphlet containing a very detailed description of their direct reading electrical pyrometers, with a number of interesting illustrations showing the instruments themselves, and their principle and applications.

Messrs. Peter M'Intosh & Sons, Glasgow.—Circular relating to their laminated leather belting.

Messrs. Veritys, Ltd., Manchester.—Several new catalogues as follows: No. 520, dealing with "Aston" interpole motors; No. 521, describing the "Cyclax" slow-motion starting switches; and 522, particularising the Peard patent switchboard type fuse. Prices are given.

Messrs. Bergtheil & Young, Ltd., London, E.C.—New illustrated price list of "Bandy" flexible couplings (Zodel-Voith patent), which embody the latest developments of the Rafford type of flexible coupling.

Messrs. Holden & Brook, Ltd., West Gorton.—Picture postal card showing their patent "protected seat" stop valve, with a diagram showing the increase of sales.

Messrs. Ferranti, Ltd., Hollinwood.—Illustrated list No. 72 of single-pole, double-throw, slow-break knife switches.

Messrs. Geipel & Lange, London.—Illustrated price list of Ward-Leonard field rheostats.

The A.E.G. English Manufacturing Co., Ltd., London.—Circular showing a decorative fitting for the "Luna" Nernst lamp.

Messrs. Sessions & Sons, Ltd., Gloucester.—List of prices of electrical slabs in plain and enamelled slate and marble.

Messrs. Johnson & Phillips, Ltd., Old Charlton.—Hanging telephone card for use of customers and friends. Copies may be obtained on application. There are three direct lines to Charlton, and extension lines to all the various departments.

Book Notices.—"Clarkson Bulletin." Vol. II. Parts 1, 2, 3 and 4. 1905. Potsdam, New York: Issued quarterly by the T. S. Clarkson Memorial School of Technology.

"The Engineers' Pocket Dictionary." French-English. By M. Lvoff. London: Percival Marshall & Co. 1s. 6d. net.

"Journal of the Franklin Institute." Vol. CLXI. No. 2. February, 1906. Philadelphia, Pa.: The Institute. 50 cents.

"Determination of the Specific Electrical Resistance of Coal, Ores, &c." By G. C. Wood; and "The Unwatering of the Achddu Colliery, with a Description of the Riedler Express Pump." By J. Morris. Excerpts from the *Transactions* of the Institution of Mining Engineers. Newcastle: The Secretary of the Institution.

"Les Accumulateurs et les Piles Electriques." By J. A. Montpellier. Paris: J. B. Baillière et Fils. Fr. 5.

"Patents to Inventors." By A. H. Stanley. London: Percival Marshall & Co. 3d. net.

"The Dielectric Strength of Air." By Alex. Russell. Excerpt from the *Proceedings* of the Physical Society of London.

"Frenzied Finance." By Thos. W. Lawson. London: Wm. Heinemann. 6s.

The forthcoming publication of the "Engineering Index" for the five years 1900-5 is announced by the *Engineering Magazine*. It will contain over 1,200 pages, indexing 39,000 articles and papers of permanent value on engineering subjects which have appeared in nearly 200 technical journals, &c. We have found the preced-

ing volumes so very useful that we look forward with pleasure to the appearance of this excellent work.

Trade Announcements. — In connection with the recent comments and correspondence in our pages regarding cable contracts at Walthamstow, Messrs. Connolly Bros., Ltd., inform us that Messrs. Chas. F. Quicke & Co., of 315, Euston Road, London, N.W., have for many years been their agents in London, holding stocks of their goods, and that they do not deal in any description of electrical wires and cables except those made by that company.

Messrs. Aston Bros., Ltd., engineers and merchants, of Dublin, notify that their branch office at Ocean Buildings, Belfast, will be discontinued, and their North of Ireland business will be conducted from 38, Donegall Street, Belfast. They have made arrangements to continue the business carried on at that address by Messrs. Smith & Parkes, under the management of Mr. F. Walford Parkes. In addition to the contracting business hitherto carried on by Messrs. Smith & Parkes, they have made arrangements to carry a representative stock of mechanical and electrical supplies.

Messrs. R. J. Nicholson & Co., 26, Cannon Street, Manchester, have been appointed sole agents in Lancashire and district for Messrs. Hugh Scott & Co.'s (Belfast) electric motors.

The Cleveland and Durham County Electric Power Co. notifies that from March 1st its address will be Hinton's Buildings, Middlesbrough.

Pipework Contracts.—Messrs. Edward Le Bas and Co., of Billiter Street, E.C., and Millwall, have in hand pipework contracts for the Boroughs of Shoreditch, Fulham, Barrow-in-Furness, and the city of Gloucester, and have just completed similar contracts at Middlesbrough, Poplar, Plymouth and Swindon.

Bastian Lamp.—In the *Ocean Express* for the 3rd inst. there appears an article on the "wonderful new 'Bastian' light," in which a number of applications of the Bastian mercury vapour lamp are illustrated—mainly for street lighting—and the lamp, as well as its inventor, are eulogised in somewhat fulsome language. It is stated that the lamps are now being delivered at the rate of 100 per week.

With this number of the *Ocean Express* is bound up the monthly supplement, the *Ocean A.B.C.*, a wonderful compendium of information for travellers.

Cable Conduit.—A correspondent sends us particulars of a system which he has devised for protecting underground cables without the defects of the present "solid system." Instead of supporting the cables on bridges at intervals, he provides a continuous wooden casing for the cables, supported on bridges inside an outer trough. The top of the casing is removable; the cables are laid in position, the cover fixed on, and the whole is then surrounded with melted bitumen, which fills the space between the inner casing and the outer trough in every direction. Numerous advantages are claimed for this system by the patentee, Mr. W. Higgins, of 21, Villas Road, Plumstead, who also has ways of his own of impregnating wood, paper, &c., and of reclaiming rubber from old cables.

Country House Lighting.—Messrs. R. J. Nicholson and Co. have recently carried out an interesting E.L. installation at a country house near Hereford. The plant consists of a 4-B.H.P. "Ideal" petrol engine direct coupled to a dynamo, a battery of accumulators, and a fully equipped switchboard. A special feature of the petrol set, to which we have drawn attention on previous occasions, is its simplicity of construction. It can be completely dismantled and reassembled in less than an hour. Absence of complication means fewer risks from breakdowns, which is a consideration in localities where a skilled man is not on the spot.

LIGHTING AND POWER NOTES.

Boston.—Terms have not yet been come to between the T.C. and the National Provincial Electricity Corporation in regard to the company's application for a prov. order. The former objects on the ground that the company has not sufficient capital to carry out the work, that the number of streets in the compulsory area is insufficient, and that the maximum price to be charged—*i.e.*, 7d.—is excessive. The B. of T. has been informed of the facts, and suggested a meeting of representatives of the company and the T.C. at its offices on the 19th inst.

Messrs. Enright have offered to negotiate with the T.C. in regard to its prov. order, and a sub-committee has been appointed to discuss terms.

Burgess Hill.—From the *Sussex Daily News* we learn that the electric lighting of the town has been inaugurated. The overhead system has been adopted, and the scheme carried out without a prov. order.

Canada.—The locomotive and car shops of the Canadian Pacific Railway at Winnipeg, which have recently been completed, are designed to do the heavy repair work for the western lines of the system, and in conjunction with them an electrical generating station has been erected for supplying power to drive the shop machinery, &c.

The power house consists of a boiler house and engine room. The former contains five B. & W. boilers of 250 H.P. each for 120 lb. pressure, fitted with superheaters; Northey feed pumps, two Green economisers of 480 tubes each, and a Webster feed-water heater. The engine room contains two 750-H.P. Rice & Sargent cross-compound Corliss engines, each direct connected to a 500-KW. three-phase, 600-volt Canadian G.E.C. generator. Exciting current is supplied by two 30-KW. generators, made by the same company, which also supplied the crane motors.

Three-phase, 550-volt induction motors are used throughout for the machine drives and the cranes. In the shops there are about 150 motors ranging in size from 1 to 50 H.P., and comprising both Westinghouse constant and variable speed types. The starting devices adopted for the former are the Westinghouse standard oil immersed auto-starters, whilst that for the variable-speed motors is a controller of the railway type with grid resistance.

The main switchboard is of marble, and consists of 11 panels, *i.e.*, five feeder panels, one totalling panel, one spare, two generator, one exciter, and one series arc light panels. There are two sets of bus-bars, and the generator and feeder switches are double throw, so that connection can be made from either set of bars. Connections to the outside circuits are made through a cable tower situated behind the board. The outside circuits are of double-braided wire carried on 40 ft. wooden poles, and on entering the different buildings terminate on oil circuit breakers, fixed as near as possible to the point of entry. From each circuit breaker leads are run to groups of motors, a group comprising not more than 100 H.P. of motors. The wiring on the walls and under the floors is in armoured conduit, but on the ceiling it is carried on porcelain insulators fixed on the roof trusses.

The lighting of the shops is effected with 110-volt enclosed Canadian G.E.C. arc lamps, supplemented by incandescent lamps. Transformers to step down the pressure to 110 volts, have been installed. The shops are equipped with a complete local telephone system, with inter-connection for long-distance calls. The electrical department of the C.P.R. installed the electric lighting, and also a fire alarm system. The electrical engineer-in-charge is Mr. N. Boyd.

An electric power plant has recently been installed in the new building of the Bank of Montreal, at Montreal, to furnish light, heat and ventilation. The generating plant consists of Willans-Westinghouse direct-connected sets of 75 KW. at 125 volts, running at 460 r.p.m. Steam is supplied by three Caldwell water-tube boilers of 150 H.P. each, two being fitted with automatic stokers. During light load, supply is taken from a Gould storage battery of 61 cells and 2,000 ampere-hours' capacity. All the wiring is run in conduit.

For ventilation there are two 15-H.P. Westinghouse motors. There are also various other small motors installed for this and other purposes.—*Canadian Electrical News.*

Dover.—The T.C. has applied to the B. of T. for a loan of £4,500 for the extension of the plant at the electricity works, including the provision of a 500-KW. D.C. set with condensing plant.

Electric Driving in Cotton Mills.—In the textile industry of Bolton, which is the leading centre of the fine spinning interest, some interesting experiments are shortly to be made in the use of electricity as a motive power, in place of steam. For some time past energy has been supplied for power purposes, but its use has been, in a large measure, tentative. Recently, however, a distinct advance has been made in consequence of a decision of the Fine Cotton Spinners' and Doublers' Association to obtain electricity for driving the machinery in one group, in their extensive mills at Bolton. It is to be hoped that the new departure may prove advantageous to the Spinners' combine, and lead to other developments. In anticipation of increased orders, the Bolton Electricity Committee proposes to lay cables somewhat in advance of the actual needs of the moment. Inquiries by various firms engaged in spinning and weaving justify this step. The high-tension three-phase system will be adopted.

Enfield.—The North Metropolitan E.P.D. Co. has given the U.D.C. notice of its intention to commence the necessary works to carry out the Enfield E.L. order.

Glasgow.—The Secretary for Scotland has agreed to the Corporation borrowing a further sum of £300,000 for E.L. purposes, bringing the total sum raised for the undertaking up to £1,700,000.

The B. of T. has approved of the transfer of the Pollokshaws E.L. Order, 1905, to the Corporation.

Gravesend.—A L.G.B. inquiry was held on February 14th relative to the application of the T.C. for a loan of £7,000 for extending the E.L. station and plant.

Foots Cray.—A company, with a capital of £20,000, has been formed to acquire the undertaking authorised by the Foots Cray E.L. Order, 1901.

Hebden Bridge.—Mr. M. K. North, a L.G.B. inspector, recently held an inquiry into an application by the U.D.C. for sanction to borrow £2,570 for E.L. purposes, and criticised the Council's methods of applying the previous loan granted. The scheme has cost £978 in excess of its borrowing powers, and the

deficiency paid out of the district fund. Alterations were made in its original scheme, and instead of putting down two 250-H.P. sets, originally sanctioned, one 250-H.P. and one 100-H.P. sets have been put down. The inspector said the Council had no right to depart from the original scheme without the permission of the L.G.B., and he could not say what action the Board would take in the matter. Cables laid two years ago are included in the present application.

Halesowen.—Notice of the revocation of the 1899 electric lighting order appeared in the *London Gazette* for February 16th.

Hereford.—The T.C. has received from the L.G.B. sanction to borrow £4,550 for mains extensions.

Horley.—The *London Gazette* for February 16th contains notice of the B. of T. revocation of the 1904 electric lighting order.

Ince.—The U.D.C. on February 14th decided to accept the terms offered by Wigan T.C. for the transfer to it of the Ince E.L. order.

India.—In the schedule of requirements for new major works for 1906-7, we find provision made for Rs. 17,936, to meet the cost of the electrical installation at the G.P.O., Madras.—*Indian Engineering.*

It has been suggested, as a partial solution of the transport difficulty in connection with the Bengal collieries, that the coal should be utilised on the spot for generating electricity and transmitting the energy to the industrial cities. Such a scheme has already been outlined in *The Statesman* for the transmission of electrical energy from the Jherriah coalfield to Calcutta to drive the machinery of the jute mills.

London.—L.C.C.—A loan of £15,210 has been granted to the Hammersmith B.C. for extension of boiler house, mains, transformers and sub-station.

It has been decided to oppose various London Power Bills, 12 in number, including Hackney, Shoreditch and Stepney. It was remarked that £100,000 was expended by local authorities in opposing one Bill in the last session. Sir Thos. Brooke Hitching is of opinion that Bills should not be promoted by the L.C.C. until approved by the local authorities concerned. In the present case the proposal is merely a waste of the ratepayers' money.

Poplar.—To effect a further saving in the works cost, the electrical engineer has recommended the provision of an overhead bunker with equipment at a cost of £3,000. The scheme has been adopted by the Electricity Committee, and tenders are to be invited for the work.

Bermondsey.—The district auditor has taken exception to the system upon which the statement of profit and loss on the electricity undertaking is based, with a result that a reduction of £209 on the profit of the year is shown.

In regard to a loan of £5,390 for additional plant, the L.C.C. has asked, in view of the various bulk supply schemes ahead, if the plant is necessary for immediate needs. The B.C. states that it is necessary.

Shoreditch.—A loan of £5,000 has been applied for in connection with the change of pressure of supply.

Camberwell.—The County of London Electric Supply Co., has appealed against a condition of the B.C. that mains laid in the borough with its consent should be used solely for the purpose of supplying electricity within the borough. The L.C.C. has deputed its chief engineer and solicitor to attend any inquiry which may be held by the B. of T., and to support the B.C. in the matter.

Manchester.—On and after March 31st next, the charges for electrical energy made by the Corporation for power purposes will be reduced. At present the rates are a little complicated. They are based on the number of units consumed per electrical horse-power of the consumers' maximum load, according to a scale which begins with 1¾d. per unit, in any quarter, when the units consumed are less than 150 per H.P., and ends with 1d. per unit in any quarter when the units consumed are 450 per H.P. and upwards. It is proposed, subject to the approval of the City Council, to apply the following scale:—In any quarter when the units consumed are below 300 per H.P., 1¼d. per unit; when the units consumed are equal to, or are above 300, 1d. per unit. The advantages to be gained by this alteration, in the committee's judgment, are a probable increase in consumption, a simplification of terms, which should conduce to an easier understanding with consumers, and the greater popularity of the supply, besides a considerable saving in clerical and other work. If the reduced rates are approved, it will be advisable, the committee thinks, to have a minimum charge for power purposes of 7s. 6d. per quarter (as now charged to lighting consumers), the minimum charge, however, to apply to new consumers only—viz., those connected after March 31st.

The Electricity Department is proposing to develop the sale of energy for radiator use. It is suggested that radiators be supplied to customers on the hire-purchase system, the scale of charges to be the same as the proposed new rates for power. By the reduction suggested the department hopes to successfully compete with economically provided plants, such as suction gas plants and oil engines. The committee has orders for the supply of energy to several large industrial undertakings, including a cotton mill, in the city.

The Electricity Committee is opposing the Lancashire Electric Power Co.'s Bill on the ground, chiefly, that its promoters are seeking to compete with Manchester in the areas of Heaton Norris, Levenshulme, Gorton, Denton, Audenshaw, Droylsden, and Failsworth. In these districts the provisional lighting orders obtained by the local councils have been taken over by the Manchester Corporation.

New Zealand.—Wellington.—In reference to the note in our issue of November 24th last, Mr. G. S. Maben, the engineer and manager to the City of Wellington E.L. and Power Co., informs us that the City Council has not decided to give notice of its intention to purchase the company's undertaking. The figures given as the purchase price that would have to be paid in terms of the Act, represent only the amount expended on plant, for which amount the Council, it appears, assumed it could purchase the undertaking. Mr. Maben says that it is necessary to charge the high rate of 1s. per unit (not flat rate), with a large sliding scale discount, which varies from 3d. to 6d. up to 600 units, and with a gradual increase of discount beyond, in order that accounts may be paid promptly. The average price obtained for lighting is 6·25d. The charge for power, heating, &c., is 3d. per unit. The City Council pays the company, approximately, £3,600 per annum, and not £8,000, as we mentioned. Our note was written from the local report of the Council's minutes.

Power Supply Bills.—There is evidence that there will be considerable opposition to the Shropshire, Worcestershire and Staffordshire Power Bill from the local authorities affected.

Plymouth.—The T.C. has decided to supply energy to the tramways at 1·75d. per unit.

Rochester.—The Kent Electric Power Co. has just commenced the erection of a large new generating station at Frindsbury (Rochester), close to the bank of the Medway, where the company will build a new pier &c. Messrs. Babcock and Wilcox are to put in the boilers.

Scunthorpe.—The L.G.B. has informed the U.D.C., with reference to the recent inquiry, that there was no weight of evidence that the demand for E.L. would ensure a financial success.

South Africa.—Bethlehem.—Messrs. Harris, Lee and Co., electrical engineers, of Johannesburg, have secured the concession for lighting the town.

Kimberley.—Two native employés of De Beers were electrocuted by grasping the stay wire supporting an electric light post. In the first case a wire had become live by defective insulation, due to rain. The head electrician deposed that there was only a pressure of 80 volts alternating on both pole and wire stay. In the second instance a flash of lightning struck and discharged on the wires, fused the filling, escaped down the wire and struck the deceased when he touched the wire.

Johannesburg.—The first electrically-driven hoist of any magnitude was lately put in operation on the Village Main Reef mine. The three-phase motor is designed for 2,000 volts. Energy will be supplied not only to the hoist, but also for the crusher mill, tube mills, &c. The central station and the hoist were erected by the A.E.G. Electrical Co. of South Africa, Ltd., which also supplied the whole of the electrical plant.

Cape Town.—At the meeting of the City Council on January 28th, it was moved that the item, £12,500, for street lighting be reduced to £11,500, and that an additional £1,000 be set down for new lamps. A saving could be effected by switching off the existing lights at 2 a.m. instead of letting them burn for some hours longer. The matter was referred to the Streets Committee.

The following abstract of the probable revenue and expenditure of the Council in connection with the electric lighting works for the year 1906 has been published, viz.:—

Revenue.		Expenditure.	
By sale of energy to private consumers	£46,500	To management and working	£34,920
Street lighting and Corporation purposes.. ..	15,000	Plant extensions	2,100
Private connections and miscellaneous	1,597	Sinking fund and interest..	14,000
		Depreciation	9,000
		Net profit	3,077
	£63,097		£63,097

South America.—Argentine Republic.—Mr. F. K. Cassels has placed before Congress a draft proposal, for a concession to utilise the Falls of Iguazá for generating electrical energy and distributing it in the Republic. The proposal is a large one, and the terms asked for are as follows:—Sole use of the Falls for 90 years; free grant for the same period of all lands required for station buildings, &c., and for the erection of conductors, &c.; use of public roads for transmission lines; tariffs to be fixed every three years by a committee, and these to be based on the capital invested so as to give 6 per cent. per annum during the first 45 years and 5 per cent. after, this after all expenses, depreciation, &c., have been provided for. At the expiration of the period asked, all the company's assets to become the property of the Government. During the term of the concession it is desired that the company shall be free from all rates and taxes, and be able to import all plant required free of Custom's duties. Power to transfer the concession is asked for, and Mr. Cassels has agreed to deposit $50,000 as a guarantee.

The Review of the River Plate says that the Bahia Blanca North-Western Railway Co. has bought out the E.L. Co. of Bahia Blanca, and the entire plant and installations will be renewed.

Chile.—The *Board of Trade Journal* states that a concession has been granted to Don V. Hudtuvalcker, representing the Iquique Lighting Co., for the electric lighting of Iquique for a term of 10 years.

Sunderland.—A resolution has been passed by the Corporation to oppose the Bills promoted by the County of Durham Electric Power Supply Co. and the Newcastle-upon-Tyne Electric Supply Co. However, some members of the Corporation evidently study the interests of the ratepayers, for which purpose they were elected, although the majority of them seem not to realise it.

Councillor Hope agreed that their interests should be safeguarded, but contended that the Corporation could not claim customers as their own. If the company could supply the inhabitants of the town cheaper than the Corporation, then it was not fair to debar those customers from benefiting from the advantages which would be conferred upon them by competition. Councillor Summers also urged that they had no right to stop progress and prevent the competition of private individuals, who might sell at a less price than the Corporation.

Willington.—The U.D.C. has decided to maintain its opposition to the application of the Mid-Durham E.L. Co. for a prov. order for E.L. The company had offered to come to an agreement with the Council with regard to the use of overhead wires in order that the opposition might be withdrawn, but the Council felt that the order would give the company an undesirable monopoly.

TRAMWAY AND RAILWAY NOTES.

Bradford.—The Corporation has decided, in the course of a debate in which it was freely admitted that the present authorised speed limit of twelve miles an hour for tramcars is greatly exceeded, to apply to the B. of T. for sanction for a seventeen miles an hour limit.

Continental Notes.—Italy.—According to the *Bolletino delle Finanze*, &c. (Rome), the Italian Comitato Superiore delle Strade ferrate, after having examined the project of the Società Veneta for the construction and exploitation of Sicilian "complementary" railways, has decided to accept a new project presented to the Minister of Public Works by the Compagnia per le Ferrovie Complementari d'Italia, a company recently established in Paris with French, Italian and Sicilian capital. The new offer sensibly diminishes the amount of Government subvention required. It is proposed to construct about 500 kilometres of line in the island, and to put them into working within seven years. Moreover, the company engages to open to traffic at least 100 kilometres within three years. The railways will be worked by electric traction. The electrical energy will be specially derived from the River Sosio, which runs through the provinces of Palermo and Girgenti. The company also offers to utilise the electrical energy remaining from the lighting of various municipalities, offers considerable reductions in the tariff for passengers and goods, and will quote special rates for workmen.

A concession has been granted for the construction of an electric railway, 40 kilometres long, between Briga and the Ghiacciaio del Rodano.

The *Bolletino delle Finanze* reports that some two months ago the Società della Sila presented to the Minister of Public Works an application for a concession for the construction and exploitation of an electric railway—narrow gauge and 168 kilometres long—destined to join Cosenza (the chief town of the province) and the Port of Cotrone. The plans were submitted to the Circolo Ferroviaro di Napoli, who have reported in favour of the scheme. It is anticipated that the concession will now be granted, and that work will shortly be commenced on this important line.

According to *L'Elettricita* (Milan), a meeting has been held to promote the construction of an electrical tramway from Cuneo to Carru. The Communes interested will subscribe a sum of 300,000 lire, to which the Province will add 100,000 lire for subvention purposes.

The Teramo Provincial Council has petitioned the Italian Government for a subsidy, with a view to constructing an electric railway between Montesilvano and Penne.

A company has lately been formed in Venice, with a capital of £40,000 and the title La Società per le Tramvie del Lido Venezia, to construct an electric tramway on the Isola de Lido.

Spain.—It is stated that a new electric railway is shortly to be opened, uniting the works of the Sociedad Nueva Montana with the iron mines at Camargo. The length of line is about 8 kilometres, and the most noteworthy feature of the line is the tunnel of Las Presas, about 712 metres along, which has been constructed by Engineer D. Jose Maria Lopez Dori.a.

The Director-General of Public Works has granted a concession to the Sociedad Tranvia del Este de Madrid for the construction and exploitation of an electric tramway from La Ronda de Valen to La Glorieta del Puenta de Toledo.

It is proposed to grant a concession to the Société d'Electricité et de Traction en Espagne for the construction and exploitation of a secondary railway from the mine San Roque, province of Linares, to La Carolina. An application for such a concession has been made to the provincial governor at Jaen.

Germany.—Plans are being prepared in respect of a projected electric tramway between Niendorf and Hamburg.

It has been decided to construct an electric railway from Mainz to Kostheim, and to extend the electric tramway system of Mainz from the Rheinallee to the Ingelsheimer Aue.

Tenders are about to be invited for the construction of an electric tramway in the town of Langensidwalbach.

The electrical normal gauge railway which is to connect Blankenese, Hamburg and Ohlsdorf, forms an important part in the extensive railway conversion work to be inaugurated in the autumn of this year. The large power station installed for these railways by the Siemens-Schuckert Works, at Altona, is to be one of the most remarkable and extensive plants of this kind, a special feature being that it is the first German power station immediately producing and supplying to the trolley-wire single-phase alternating-current for railway purposes. Four large turbo-dynamos generating single-phase current at 6,300 volts pressure and 25 cycles, and having an aggregate output of 10,000 H.P., are at first to be installed. The 6,300-volt current is supplied immediately to the railway section as far as Hasselbrook, while in the other portion of the line the current in the power station, owing to the great distance, has to be transformed up to 30,000 volts by means of two transformers, being conveyed through two long-distance lines about 15 km. in length to the Barnbeck transformer station, there again to be reduced to the required pressure of 6,300 volts. Four smaller turbo-dynamos of 600 KW., with converters, which are mainly intended to supply the electric lighting, have been constructed by the Lahmeyer Works. The switching plant, which has been installed in a special building, is an extremely interesting feature to engineers, being designed according to the very latest experience in this line.

The recent inspection by the members of the Berlin Electro-technical Society of the site of the extension of the Berlin Elevated and Underground Electric Railway was accompanied by the presentation of an explanatory report dealing with the scheme. At present the terminal point of the underground line is situated at the Knie station, and it is from this spot that the extension is to be made to the West End, with a branch leading to the Wilhelms Platz. The total length of the extension will be 2·79 miles, of which 1·67 mile represents the main section termed the Knie-West End; the Knie-Wilhelms Platz section is to be taken in hand first. In all there will be four stations on the main line, the first being at Krumme Strasse, where the branch to the Wilhelms Platz begins. The station at Krumme Strasse has four tracks, two for the through traffic towards the West End, and two for the branching-off service to the Wilhelms Platz. The construction of the tunnel is in its material features the same as in the case of the existing underground section. An underground sub-station is being built at the Krumme Strasse station for the working of the extension, the current being supplied provisionally from the company's power station in the Trebbiner Strasse pending the establishment of a new station at Charlottenburg. As the existing power station has no space available for the erection of new polyphase current generators, the direct current there produced will, by means of motor-generators, be converted into polyphase current at 520 volts, and after transformation to 10,000 volts will be transmitted to the sub-station, where a fresh transformation by means of motor-generators will take place. The sub-station comprises a main switch room, motor-generator room and a battery room, the latter containing 370 cells capable of giving 888 amperes for one hour. It is proposed to install a further battery of smaller size for the lighting of the station, and the tunnel will be lighted from the railway working conductor at 750 volts.

The Bavarian Minister of Railways has for some time past had in progress an investigation as to the water-powers available in the Alpine district which would be suitable for the generation of electrical power for the working of the State railways, and it is possible that a memorial on the subject will shortly be presented to the Diet. It is stated to be the opinion both in Government and Parliamentary circles that no further important sources of water-power should be allowed to pass into private possession, but that everything should be assured to the State. The proposed Walchensee undertaking, which would be the largest water-power enterprise on German territory, is also to be carried out by the State, but it is undecided as to the amount of power which would be utilised for the State railways. In this connection it is pointed out that the complete transformation of the Bavarian railways to electric traction would be out of the question, as, "in case of mobilisation, Germany could not possibly dispense with the thousand locomotives in Bavaria," whereas electric traction would not allow of an uninterrupted service between State and State—a matter of great importance in the event of mobilisation. In these circumstances it is considered that the Bavarian Government will merely make an experiment on a main line, probably between Munich and Lindau, on the Lake of Constance.

Switzerland.—United States Consul Keene reports that work on the construction of the railway to the summit of Mont Blanc has begun. The line will have a total length of 11½ miles, and is to be completed within five or six years. The train will be composed of an electric locomotive and two saloon cars made to accommodate about 80 people.

A concession has been granted to a syndicate for the construction of an electric tramway between Versoix and Divonne-les-Bains, *viâ* Nyon, Prangins and Coppet. The cost of the enterprise is estimated at about £38,000, of which about £7,972 is to be expended on rolling stock.—*Board of Trade Journal.*

Austria.—A concession has been accorded by the Ministry of Railways to the Brünn Electric Street Railways Co. for the building and working of electric tramways in the town and outskirts.

A concession has been granted to the municipality of Trient for

the construction and working of an electric line from that city through S. Michaele and Cles to Malé, with a branch from S. Michaele to Mezzolombardo.

Folkestone.—Consequent upon its support of the Tramway Bill of the National Electric Construction Co., Folkestone T.C. on February 14th decided to oppose the Folkestone, Sandgate and Hythe Tramways Bill promoted by Mr. Sellon.

Hythe T.C., which has also decided to support the National Electric Construction Co.'s scheme, has, however, declined to oppose the Bill promoted by Mr. Sellon.

Sandgate U.D.C. has received the consent of the B. of T. to purchase the section of the South-Eastern and Chatham Railway Co.'s tramway which is within the Council's district. At present the tramway is worked by horses.

Gorton.—Work has been begun on a new tramway system which will be of great benefit to this working-class suburb of Manchester. The Manchester Tramways Committee, which some time ago came to an agreement with the Gorton District Council, is laying lines to connect Stockport with Gorton and Openshaw, and by a circular route (without passing directly through the city) with the Cheetham Hill district. The traffic on the new lines will be worked by the Corporation under a lease identical in terms with that relating to the Gorton and Denton traffic.

Greenock.—The employés of the tramway company threatened to come out on strike should the company insist on enforcing a new rule by which a week's wages was to be retained as lying time. The company withdrew the rule before any action was taken by the men.

Kingston-on-Thames.—The Corporation has given permission for the new electric tramways, which cross Kingston Bridge, to be opened on March 1st, subject to the B. of T. inspection proving satisfactory.

Liverpool.—After a long discussion at an adjourned meeting of the Liverpool City Council, the rearrangement of the managerial duties of the tramways and electrical departments of Liverpool, recommended by the Tramways Committee, was carried. The recommendations of the Committee provide for the tramways and the electric power and lighting undertakings being managed by one Committee, to be called the Tramways and Electric Power and Lighting Committee. Mr. C. W. Mallins, traffic superintendent, is appointed traffic manager; Mr. Thomas Bulmer, deputy accountant in the controller's department, secretary to the tramways department; Mr. A. B. Holmes, consulting electrical engineer, is to undertake the same duties of control and supervision with respect to the electrical and mechanical departments of the tramways as he now performs with respect to the electric supply department, and Mr. Alfred Clough, resident electrical engineer, electric supply department, is appointed resident electrical engineer to the tramways department.

Liverpool-Southport Electric Railway.—At the Liverpool Assizes on the 15th inst. six actions were entered against the L. & Y. Railway Co., claiming damages for death or injury arising out of the Hall Road disaster on the electric railway last July. The case of Mr. Benjamin Sykes, a miller, of Formby, in an extensive way of business in Liverpool, was gone into. Mr. Sykes and his brother were killed in the accident. He was 60 years of age, and his business for the last three years yielded an annual profit of £1,400. He left a widow, six sons and five daughters. Counsel for the plaintiff complained that under the present law £3,200 accruing to the estate from accident insurances as a result of the thrift and forethought of the deceased, would have to be deducted from any amount the jury might award, remarking that it was strange that a person who killed another should have the benefit of his insurances. The jury awarded £2,950 net, apportioning it among the children, the widow receiving by will the whole income of the estate. In a second case Geo. Ellis, a working gardener at Southport, was awarded £300 for the loss of his son, Sidney Ellis, upon whom he was partly dependent. Two other cases were settled on terms which did not transpire.

London.—Metropolitan District Railway.—It has been decided to abandon the idea of adopting "zone fares" owing to certain difficulties connected with the arrangements of other companies. The two-minute service is to be inaugurated next month, during the busy periods of the day.

On Friday last one of the axles of an electric train broke while proceeding out of the Mansion House Station, and for two hours all traffic to the West on the outer circle was completely blocked.

The service was again interrupted on Tuesday for nearly two hours, between nine and eleven o'clock, due to an engine running off the line.

Brighton Railway.—The contracts have been signed for the electrification of the L.B. & S.C. Railway Co.'s suburban line between London Bridge and Victoria, *via* Rye Lane, and it is expected that the work will be accomplished within eighteen months. In a recent interview with a representative of the *Tribune*, Mr. Philip Dawson said that the equipment of the line would cost less per mile than the electrical work on the Metropolitan, the District, or the Lancashire and Yorkshire Railway.

Manchester.—The rejection by the ratepayers, as the result of the recent poll of the Manchester Corporation Bill, which contained, amongst other things, certain tramway extension proposals, has disappointed many people. The Corporation has always aimed at making the tramway system the natural artery of communication between the city and the great residential suburbs. It was hoped at an early date to begin work on the lines authorised by the Manchester Southern Tramways Act. Now the citizens' vote will mean a reconsideration of the position, so far as the proposals to run trams into Cheshire are concerned. It is not supposed, however, that the projects which have been the subject of negotiation with various local authorities will be abandoned. The city has already spent a considerable amount of capital, and a withdrawal now would mean a serious sacrifice. What the Corporation sought, by its omnibus Bill, was the power to purchase land compulsorily for road widening, and an extension of the time during which powers already existing might be exercised. It is significant of the Manchester Tramways Committee's attitude that at a meeting of the Urmston D.C. last week, a letter from the town clerk of Manchester was read intimating that in consequence of the adverse vote of the Manchester ratepayers, it had been decided to drop the Urmston Tramways Clauses of the Manchester Bill, but that the remainder of the Bill (which contains a provision for a three years' extension of the period for constructing lines authorised by the Southern Tramways Act) was to be submitted to a vote of the ratepayers.

Weston-super-Mare.—The U.D.C. has decided to oppose the application of the local Electric Supply Co. for power to construct a relief line of tramways on the Marine Parade.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—The Commonwealth Government, having allowed the Eastern Extension Co. to open private offices for the receipt of messages in the capital cities, is now to extend the same concession to the Pacific Cable Board. The two concerns are to have separate telegraph lines between the capitals, a departure which will involve the construction of a special line between Melbourne and Sydney for the Pacific cable, at the cost of several thousand pounds. This and other works are considered necessary in order that the Federal Government may fulfil its promise to the Pacific Cable Board to give to that body precisely the same advantages as are now enjoyed in Australia by the directors of the Eastern Extension Telegraph Co.—*Australian Mining Standard.*

Glasgow.—At a recent meeting of the T.C. a Councillor gave notice of motion to the effect that the Common Good should make a grant of £50,000 to the Corporation Telephone Department, in order that it might better meet the opposition against it.

International Telegraphs.—The Bureau International des Administrations Télégraphiques has just issued its report for the year 1905. The countries adhering to the Telegraph Convention are as follows:—Germany, Argentina, Australia, Austria, Belgium, Bosnia-Herzegovina, Brazil, Bulgaria, Cape of Good Hope, Ceylon, Portuguese Colonies, Crete, Denmark, Egypt, Spain, France, Algiers, Great Britain, Greece, Hungary, British India, Dutch-India, French Indo-China, Italy, Japan, Luxemburg, Madagascar, Montenegro, Natal, Norway, New Caledonia, New Zealand, Orange River Colony, Holland, Persia, Portugal, Roumania, Russia, Senegal, Servia, Siam, Sweden, Switzerland, Transvaal, Tunis, Turkey and Uruguay.

The telegraph and cable companies are divided into three groups. Under the head of adherents are the Black Sea, Commercial, Deutsch-Atlantische, Eastern-Europe, French, German-Dutch, the Rio de la Plata, Telegraph and Telephone, Direct Spanish, Direct West India, Eastern, Eastern Extension, Great Northern, Halifax and Bermudas, Indo-European, South American, Spanish National, West African, West Indian and Panama, and Western Telegraph Companies.

The second group are constituted by those which, though not official adherents, generally conform with the service regulations, and the following names appear here:—

African Direct, Amazon, American Telegraph and Cable (W.U. Co.). Anglo-American, Central and South American, Commercial Pacific, Direct United States, Eastern and South African, Europe and Azores, Pacific and European, and West Coast of America Telegraph Companies.

The third group is composed of the British North Borneo, Cuba Submarine, India-Rubber, Gutta-Percha and Telegraph Works, Mexican, River Plate, and United States and Hayti Telegraph and Cable Companies. These companies only correspond with the Bureau International through one or other of the companies above named.

London.—Post Office Telephones.—On Saturday last an exceptionally smart piece of work was carried out. In order to effect improvements in the "Central" Exchange, and to render it fireproof, the whole of the subscribers were changed over to the new "City" Exchange. Arrangements had previously been made for the transfer by coupling up the lines to the latter exchange, with separators in the heat coils; when the signal was given, the separators were rapidly removed, the actual operation occupying 80 seconds, and affecting about 15,000 lines. The staff at once proceeded to test all the lines, and to make the change permanent. The process involved very little interference with the ordinary service, though there was some delay in getting through on Monday.

New Atlantic Cable.—Another new cable is to be laid across the Atlantic in connection with the Commercial Cable Co.'s system.

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Municipal Telephones.—Last week a conference of representatives of municipalities owning telephone services was held in London, and arrangements were made for approaching the Postmaster-General with a view to the renewal of the licences.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Dominica-Martinique	May 7, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	..
Cayenne-Pinheiro	Aug. 15, 1902	..
Port Arthur-Chifu (Closed)	Mar. 7, 1904	..
Jamaica-Colon	Jan. 5, 1905	..
Cadiz-Tenerif	July 20, 1905	..
Tarifa-Tangier	Jan. 18, 1904	..
Puerto Plata-Martinique	Oct. 30, 1905	..
Panama-Buenaventura	Feb. 1, 1906	..
Buenaventura-St. Elena	Feb. 1, 1906	..
Vladivostock-Nagasaki	Feb. 7, 1906	..
St. Vincent-Grenada	Feb. 16, 1906	..
St. Vincent-St. Lucia	Feb. 16, 1906	..
Tangier-Cadiz	Feb. 18, 1906	..
St. Jacques-Haiphong	Feb. 14, 1905	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..
Communication with Brazil *via* Galveston	July 18, 1905	..
Communication with Alaska *via* Seattle	Jan. 17, 1906	Feb. 14.
Bachkale-Deliman	Feb. 12, 1906	..

Spain.—A Royal Commission has been appointed to report on the most efficacious and speedy means of establishing a submarine cable between Cadiz and Santa Cruz (Teneriffe).—*Board of Trade Journal.*

West Indies.—The newspapers have reported earthquakes in the West Indies, and the interruption of cables between St. Vincent and St. Lucia, and St. Vincent and Grenada, cutting off St. Vincent and Barbados.

Wireless Telegraphy.—It is announced that the large station for wireless telegraphy, which is being established by the German Government near Norddeich, and to which reference was made in this journal some time ago, will soon be completed and ready for use. It will prominently serve the interest of the Post Office authorities, it is said, and, first of all, will place in communication Berlin, Bremen and Hamburg. The station, which will have a radius of action of 930 miles, will cover nearly the whole of Europe to St. Petersburg easterly, and Naples in a southerly direction. It will be worked by three officials of the Emden telegraph office, who are at present undergoing a special course of instruction at Berlin for this purpose. In addition to this station, a second one of smaller size is to be built "in the interest of the German navy" at the second harbour entrance at Wilhelmshaven. This station is intended to place the latter port in direct communication with Borkum and Heligoland. A station for wireless messages already exists at Borkum, this being the first established on the German North Sea coast. It is in connection with the Borkumriff lightship, and is now exclusively used for shipping purposes.

The experimental station at Machrihanish, on the Mull of Kintyre, built by the Brown Hoisting Co., of New York, to the order of the National Electric Signalling Co. of America, has been completed. The signalling tower, which is composed of tubes, is about 450 ft. high and 5 ft. in diameter, and in its hollow interior are ladders for ascending. The mast is topped with a cap, bristling with spikes. A network of wires, laid in trenches in the ground and covered with earth, leads into a deep trench along the shore. The corresponding tower on the American side, which was completed some time ago, is situated on the coast of Massachusetts, close to Boston. It is stated that communication has been opened between Machrihanish and other "wireless" stations in the British Isles.—*Standard.*

CONTRACTS OPEN AND CLOSED.

OPEN.

Barnes.—March 12th. Water-tube boiler, condenser, pump and pipe-work, for the U.D.C. See "Official Notices" to-day.

Bilston.—March 12th. Electric lighting of the new schools now being erected at Stonefield. See "Official Notices" February 9th.

Cardiff.—February 24th. Electric light fittings for the New College buildings in the Cathays Park, Cardiff. Architect, Mr. W. D. Caroe, 8A, Whitehall Place, London.

Croydon.—March 1st. Wiring and electric lighting necessary in the Central Fire Station, Park Lane, Croydon. Mr. Geo. F. Carter, Borough Engineer, Town Hall, Croydon (deposit one guinea).

Dublin.—March 1st. Electrical works and supplies for buildings of the Commissioners of Public Works. Mr. H. Williams, Secretary, Office of Public Works, Dublin.

Edinburgh.—March 12th. Carbons, pavement boxes, meters, service fuse boxes and bitumen, for the Corporation. See "Official Notices" to-day.

Erith.—March 12th. Stores for the electricity works. See "Official Notices" to-day.

Halifax.—February 27th. A 30-35-B.H.P. motor tower wagon for the tramways department. See "Official Notices" February 9th.

Hornsey.—February 26th. Cables, junction boxes, fuse boxes, meters and cable stores. See "Official Notices" February 9th.

Huddersfield.—March 9th. Vertical engine and piping; 750-KW. traction generator; switchboard and cable extensions, for the Tramways Committee. See "Official Notices" to-day.

Ilford.—February 26th. Meters, cables, lamps, carbons, &c., for the electricity department. See "Official Notices" February 16th.

Johannesburg.—March 31st. 350 street lamp fittings, 50 stays for ditto, and 600 ft. gas barrel for the T.C. See "Official Notices" February 16th.

Leeds.—April 9th. Steam turbine, two-phase alternator and exciter (3,000 KW.), condensing plant and piping, for the electric lighting department. See "Official Notices" to-day.

L.C.C.—March 26th. Lighting and power installation for the Long Grove Asylum, Epsom, now erecting. See "Official Notices" to-day.

Manchester.—March 3rd. Stores for the Corporation tramways. See "Official Notices" to-day.

Pontypridd.—March 3rd. Reservoir, condensing plant, cooling tower and tank, and artesian well for the U.D.C. See "Official Notices" February 9th.

Portsmouth.—March 5th. Water-tube boiler, economiser, pumps, condenser, cooling tower, and one triple-expansion 1,000-KW. slow-speed vertical generating set; switchboard alterations and additions, for the Corporation. See "Official Notices" February 16th.

Roumania.—The Municipality of Hitesci will shortly invite tenders for the establishment of an electric lighting system in that town.—*Board of Trade Journal.*

Stockport.—March 5th. Five double-deck top-covered cars, single truck type, complete with electrical equipment for overhead traction. Mr. John Atkinson, Borough Surveyor, Stockport.

Sunderland.—March 1st. Six vestibule cars, double-deck top-cover type, with approved radial trucks. See "Official Notices" February 16th.

Sunderland.—March 2nd. Feed pump, cooling tower, surface condenser, coal bunkers, &c., for the Electricity Department. See "Official Notices" January 26th.

Swindon.—March 12th. Various materials for the electricity and tramways department. See "Official Notices" to-day.

Sydney (N.S.W.).—May 7th. Boilers, stokers, pipework, turbo-alternator, sub-station machinery, switchboards, &c., for the Council. See "Official Notices" February 9th.

West Ham.—March 2nd. Lamps, cable, motors, transformers, meters and cut-out boxes, for the Electricity Department. See "Official Notices" February 16th.

West Hartlepool.—February 26th. One 500-KW. high-speed engine and continuous-current dynamo for the Corporation. See "Official Notices" February 9th.

CLOSED.

Ballaghadereen (Ireland).—The Castlerea R.D.C. has accepted the tender of [Messrs. James Gordon & Co., of London, for the hydraulic turbine, gas engine and suction plant, forming the complete power equipment of their electric lighting station, subject to the necessary loan being granted by the L.G.B.

Brighton.—The T.C. has accepted the tender of the British Insulated & Helsby Cables, Ltd., for the supply of telephone cables, at £81, and that of the Sloan Electrical Co., Ltd., for carbons for a year, at £284.

Bury St. Edmunds.—The T.C. has accepted the tender of the Electrical Power Storage Co., Ltd., for the supply of 100 positive and negative plates, 104 carboys of acid, 100 wooden trays, &c., at £364 13s.

Glasgow.—The Electricity Committee of the T.C. has accepted the following offers for fireclay ducts:—The Glenboig Union Fireclay Co., Ltd., to the extent of one-half of the quantity required; the Summerlee & Mossend Iron & Steel Co., Ltd., to the extent of one-half of the quantity required—these being the lowest offers.

Hammersmith.—The B.C. has placed an order with the British Transformer Co., Ltd., at £105, for three controlling boards on the Berry series system.

London.—The Highways Committee of the L.C.C. propose to give to Messrs. Reid Bros., who a few months ago were entrusted with a large contract for the laying of cable ducts in South London, a similar contract in regard to cable ducts between Camberwell Green and Lordship Lane at a cost not exceeding £8,000. An additional motor-generator for the Camberwell sub-station is to be obtained from Messrs. Dick, Kerr & Co., at an estimated cost of £2,000.

Poplar.—The B.C. has accepted the tender of the A.E.G. English Manufacturing Co. to maintain a minimum of 190 ½-ampere Nernst lamps in the public libraries, at 4s. 6d. per lamp per annum.

Manchester.—The Corporation Electricity Department has placed with Messrs. Bruce Peebles & Co., Ltd., an order for Peebles-La Cour motor converters:—6,000 to 500 volts, 50 periods; four 500-kw. sets, and five 250-kw. sets (repeat order).

Rochester.—The T.C. has sealed contracts with Messrs. Dick, Kerr & Co. for the construction of the extension of the electric tramway system from Star Hill *viâ* the Rochester-Maidstone Road on to Grange, for which a sum of £15,000 is to be borrowed from the Prudential Insurance Co., Ltd. It is also proposed later on to extend the trams into Borstal and Strood and Friendsbury, and so on to Gad's Hill, Higham, the residential place for some years of Charles Dickens.

Weston-super-Mare.—The U.D.C. has accepted the tender of the National Telephone Co., Ltd., for electric fire alarms, at £42 per annum for seven years.

FORTHCOMING EVENTS.

To-day's Events (Friday, February 23rd).—At 5 p.m. Physical Society. Mr. C. G. Barkla on "Secondary Röntgen Radiation." Messrs. C. W. S. Crawley and F. B. O. Hawes on "Records of the Difference of Potential Between Railway Lines, and a Suggested Method for the Observation of Earth Currents and Magnetic Variations."

At 8 p.m. Electro-Harmonic Society. Ladies' Night. Concert at the Holborn Restaurant.

At 9 p.m. Royal Institution. Prof. J. O. Arnold on "The Internal Architecture of Metals."

Saturday, February 24th.—At 6.45 p.m. I.E.E. (Manchester Students). Dinner at Grand Hotel.

Association of Engineers-in-Charge. Social Dance.

Monday, February 26th.—At 7.30 p.m. I.E.E. (Newcastle). Dr. Thornton on "The Distribution of Magnetic Induction and Hysteresis Loss in Armatures."

At 8 p.m. Society of Arts. Cantor Lecture by Sir Wm. White, on "Modern Warships." (Lecture V.)

Tuesday, February 27th.—At 7.30 p.m. I.E.E. (Manchester). Mr. T. H. Schoepf on "Single-Phase Railway Working."

Wednesday, February 28th.—At 7.30 p.m. I.E.E. (Students). "Fuses," by Messrs. H. W. Taylor and C. E. Greenslade.

At 8 p.m. Society of Arts. Captain G. S. C. Swinton on "London Traffic."

Thursday, March 1st.—At 8.30 p.m. Chemical Society Meeting.

Friday, March 2nd.—I.E.E. (Manchester). Annual Dinner.

Friday, March 2nd.—Junior Institution of Engineers. At 7 p.m. Mr. A. P. Trotter on "Acceleration and Accelerometers.' At 8 p.m.—Mr. L. F. de Peyrecave on "Gas Engine Indicators."

Saturday, March 3rd.—At 3 p.m. I.E.E. (students) visit to the P.O. Telephone Exchange, Addle Hill, E.C.

At 3 p.m. Royal Institution. Prof. J. J. Thomson on "The Corpuscular Theory of Matter."

At 8 p.m. Electrical Engineers, R.E.V. Bohemian Concert at Caxton Hall, Westminster.

At 7.30 p.m. Glasgow Technical College Scientific Society. Mr. A. Stewart on "Portable Electrical Tools and their Application to Industrial Purposes."

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, February 26th.—"A" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Tuesday, February 27th.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.; medical examination recruits, 7 p.m.

Wednesday, February 28th.—"A" badge examination for "C" and "D" Companies.

Thursday, March 1st.—"C" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Friday, March 2nd.—"D" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Saturday, March 3rd.—Week-end instruction for "C" Company (whole day). Bohemian concert at the Caxton Hall, Westminster, at 8 p.m.

J. H. S. Phillips, Captain E.E.

For O.C.E.E.R.E. (V.).

NOTES.

London Underground Railway Enterprise.—American inventive genius has been busy, as everyone knows, with the name of the late Mr. Yerkes. Among other of the matters attributed to him, with more or less inaccuracy, we find in one traction paper that he is described as the builder of London's underground railways, whereas he is responsible only for the electrification of one already existing line, and became more or less interested in certain tube schemes. It seems quite a usual thing for men in America to dub themselves consulting engineers to some or other scheme on this side, with which they have had nothing whatever to do. That the Underground Railway has been 40 years at work is a mere triviality, if an American is to be given credit for having built it this century.

The City and South London Railway is British from start to finish, and has run with uninterrupted success from the day when, as the pioneer tube railway, it was inaugurated. The Central London Railway was designed and built by British engineers, and only the electrical equipment was American; the rolling stock is British, with the possible exception of the motors. The Great Northern and City Railway, which for comfort and convenience is unexcelled, was wholly British, and so was the Waterloo and City. Granting that the old Metropolitan District Railway offered the biggest problem, and that the electrification was carried out on American lines, the fact remains that the operation has proved far from satisfactory, and breakdowns are still of frequent occurrence, to say nothing of the straphanger question.

Electric Power on the Clyde.—The use of electrical energy for driving purposes is making rapid strides at Govan, and we are pleased to note that the motor-hiring scheme of the T.C. is making headway. Mr. T. C. Parsons, the burgh electrical engineer, has forwarded us some particulars regarding the firms that are now taking a supply of electricity from the Corporation mains for driving their machinery. There are at present 40 motors of a total of 460 h.p. out on hire. Although there are a large number of very intermittent motors connected up, some of which take a very heavy load for a short time, this has been found not to interfere with the lighting at all, the overlapping practically neutralising the effect.

The Caledonian Steel Castings Co. has recently converted its steam and hand-power foundry cranes to electric driving, and has installed a motor-driven dynamo for electric welding purposes. The total horse-power of the cranes amounts to 44 and of the motor-generator to 30 h.p. The motors are all by the Lancashire Dynamo and Motor Co., and the dynamo by Messrs. Siemens Bros. The electric welding plant has proved to be of great service in filling up holes in castings, which otherwise would have been scrapped, and the energy required amounts to an average of only 5 units per hour.

The Govan Ropework Co. has adopted electric driving throughout for its new extensions, and has installed 10 motors, totalling 170 h.p. for driving the twine mills, rope walk and auxiliary machinery. The works have also been lighted electrically with 229 16-c.p. lamps and five B.T.H. enclosed arcs. The motors on the rope walk are by Messrs. Greenwood & Batley, and the others by Messrs. Mavor & Coulson.

The Glasgow Railway Engineering Co. is also using electric driving extensively in its works. The company started with a 10-h.p. motor to drive a new shop, and finding the result satisfactory, afterwards installed eight others, the total for the nine motors being 95 h.p. Of these one of 7 h.p. drives a Massey power hammer. One of 33 h.p. drives a group of tools, which include a fan for smiths' fires and spoke-bending machine. One of 10 h.p. drives through spur gear a light set of plate rolls, one of 9 h.p., a spur-driven punch and shear, an 8-h.p. variable speed motor operates a wheel lathe, two of 4 h.p. each, interpolar, variable speed, drive rim lathes, and one of 10 h.p., interpolar, variable speed, drives an axle lathe, all through spur gear. It has been found with the lathes that the increased production due to electric driving rather more than pays for the cost of energy. The amount of energy taken by the hammer motor is also extremely small, amounting to 6 units per day for a 1-cwt. hammer, knocking down tires and working 10 hours. The motors are all hired from the Corporation, and are of the Lancashire Dynamo and Motor Co.'s make.

Messrs. Murray, M'Vinnie & Co. have a 25-h.p. Mavor and Coulson motor, and two of 6 h.p. of the same make, driving groups of tools. Messrs. Murray, M'Vinnie state that since putting in the motors they have increased the speed of their machinery by 25 per cent., the motors running an average load of 15 h.p. at a cost of 11s. 9d. per day, a saving of 5s. 9d. per day over steam driving for equal power.

Messrs. Alexander Stephen & Sons, shipbuilders, have opened a new repair yard at Govan, and the machinery throughout is driven by motors hired from the corporation. The tools at present driven consist of:—Shipyard rolls, direct driven by 25-h.p. motor, punches and shears and angle cutter and countersink, direct driven by two motors, one of 7 h.p. and one of 15 h.p., plate planer, belt driven by 20-h.p. motor; machine shop, by motor of 10 h.p., and 3 cwt. Massey power hammer, direct driven by 7-h.p. motor. The motor on the shipyard rolls is very heavily compounded, the shunt winding being provided to keep the speed down on light work. A magnetic brake is provided which pulls the rolls up immediately current is switched off. The motors on the punches and shears are carried on brackets bolted to the sides of the machines, and drive direct through spur gearing. The motors are of the L.D.M. Co.'s make. Messrs. A. Stephen & Sons have also made

arrangements to take energy from the Corporation for lighting purposes at their shipbuilding yard at Linthouse to the extent of about 300 amperes.

Messrs. Dunsmuir & Jackson, engine builders and boilermakers, have adopted electric driving extensively in their shops. Nearly all the cranes are converted to electric driving, and a good many of the tools. At present there are 17 motors totalling 278 H.P. installed, and of these eight are hired from the Corporation, and drive, either by belt or spur gearing, punches and shears, travelling cranes, an hydraulic pump, drills and horizontal rolls. The travelling cranes were formerly driven by endless ropes, and were converted by the Corporation Electricity Department. The hydraulic accumulator pump motor is actuated by an automatic capstan starter, which starts and stops the motor as the accumulator rises and falls. The multiple spindle boiler shell drills are driven from a countershaft overhead through coil clutches, made by the Coil Clutch Co., of Johnstone. This arrangement was put in to save space and to avoid the use of belts as far as possible. The motor drives through spur gear on to a short piece of shafting, on each end of which is fitted a coil clutch, so that either of the two drills can be stopped without stopping the motor or the other drill. When the motor was put in, these two machines were speeded up about 25 per cent. The horizontal rolls are driven by a 15-H.P. series motor through spur gearing, and the motor is provided with a tramway type reversible controller and a magnetic brake, and it is found that a great deal more work can be got out of the rolls than when they were belt driven from a countershaft. The motors in the place are chiefly of Messrs. Royce & Co.'s make. Messrs. Dunsmuir & Jackson are putting up a large new boiler shop which will be driven throughout by electric power taken from the Corporation.

Institution Notes and Lectures. — Incorporated Municipal Electrical Association.—The secretary announces that the eleventh annual convention will be held in London during the week commencing June 18th, and the Council is inviting offers of papers from the representatives of committees and engineer members on any of the subjects stated below, or any others to be approved by the Council, affecting municipal electrical undertakings:—

"The Commercial Development of Electricity Undertakings." With special reference to publicity departments, free and assisted wiring schemes, prepayment meters, showrooms, electrical exhibitions, inspection and maintenance of consumers' lamps, canvassers, reduction of selling price of electrical energy, &c.
"Boiler House Plant." With special reference to flue gas testing, treatment of feed water, coal analysis, the actual saving (in cash) attained by using condensers, superheaters, and feed water heaters, at various load factors, &c.
"Steam Turbines."
"The Depreciation of Machinery and various Parts of the Equipment."
"Carbon Filament Lamps."
"Public v. Private Supply."
"Tramways."

Would-be contributors should forward particulars of the subjects they propose to deal with to the secretary at once.

Sheffield Society of Engineers and Metallurgists.—In the course of his address as retiring president of the above named society, on February 12th, Mr. W. H. Ellis said he had found no instance of engineers who had adopted electric driving instead of steam driving having regretted taking the step. Engineers were realising that the economy which was actually clear to see, in the way of less coal burned for a given amount of work done, did not necessarily represent the whole economy brought about by electric driving. There were many other economies to be effected by the change, though some of them were not easy to put into figures. The main question for engineers in connection with electric driving now was as to the best source of the power, whether gas engines or steam engines, whether reciprocating or turbine. The particular circumstances of each case must determine the choice, but generally speaking, for powers not exceeding 2,000 H.P., and where a good supply of water for condensation was available, steam driving was preferable; but where water was limited and a large power had to be developed, a gas installation would prove the more economical. The effect of having a good supply of producer gas available in a works for other purposes must naturally be taken into consideration in connection with the question of production for electric power. In works of a compact nature, where the distances to carry the power were not great, there was a strong feeling for adhering to the 220-volt continuous current in preference to high-tension current.

Institution of Electrical Engineers—London Students' Section.—On Thursday last week the second annual dinner of the I.E.E. London Students' Section was held at the Holborn Restaurant, about 80 being present. Mr. A. G. Ellis, chairman of the Students' Section, presided, supported by many members of the Council of the Institution. After the toast of "The King" had been honoured, Mr. C. H. Lang, vice-chairman, proposed "The President and the Institution" in brief and appropriate terms. Mr. John Gavey, C.B., President of the Institution, replied, and humorously referred to the difficulties with which he had to contend in his own young days. He eulogised our excellent technical institutions and their eminent heads, and pointed out that the Students' Section had increased from 419 members in 1900 to 1,470 at the end of January last.

Prof. W. E. Ayrton, F.R.S., past-president, also replied, recalling the days when he was taken on a tour of inspection by Mr. Gavey, who now looked younger than ever. Electrical engineering, he said, was now really commencing, and it would fall to the students to carry it rapidly up the curve of progress.

Toasting "The Students' Section," Prof. S. P. Thompson, F.R.S., said that the students could not yet realise the value of their privilege of attending the meetings of the Institution. The atmosphere there was very different from that of a college, for there they met the real men who did things, and were surrounded with the spirit of reality. An enormous amount of work was being done quietly by the Institution, there being innumerable meetings of committees engaged upon various matters.

Mr. A. G. Ellis replied, inviting the students to join the "labour" party, and to attend more regularly at the meetings. He praised the work of the hon. secretaries, Messrs. E. W. Moss and H. W. Taylor, and after reviewing the work of the past session, he stated that there would be a visit to Manchester soon after Easter.

Mr. H. W. Taylor proposed "The Guests," and, commenting on the difficulty of making a speech at the end of the evening, introduced a story about certain flame arc lamps in India. Clouds of insects collected round these lamps, and fell to the bottom of the posts; the local frogs discovered this fact, and congregated round the posts to absorb the insects, the final result being a great diminution in plague and malaria, thanks to the slaughter of the insects.

Mr. J. Swinburne, past-president, replied, repudiating the suggestion which had been attributed to him that students should neglect science and go in for commerce; he advised them to go in for both. Influenced, he said, by the "stuffed" fishes which decorated the walls of the room, he embarked upon a series of amusing anecdotes founded upon his early experiences. Mr. W. H. Patchell, vice-president, also replied, and after paying a tribute to his predecessor's talent, stated that electrical engineering practice was changing so rapidly that they were all students. As most of his staff were absorbed in Parliamentary work, there was plenty of room for students. Thanks were accorded to the hon. secretaries for their labours, and to the amateurs who ably provided the musical programme—Messrs. Nadaud, D'Arcy, Sack and Taylor.

Leeds University Engineering Society.—At a recent meeting of this Society, Prof. Charnock read a paper on the "Stability of Tall Chimneys."

Junior Institution of Engineers. — This vigorous young society's annual dinner was held at the Hotel Cecil on February 10th, the president (Mr. Dugald Clerk) taking the chair. Nearly 100 were present, and the proceedings were heartily enjoyed. A special regulation was laid down to the effect that no speech should occupy more than five minutes, on pain of reproof by an alarum clock; this rule was religiously honoured in the breach by almost every speaker. After the loyal toasts, Prof. C. V. Boys, F.R.S., proposed "The New Parliament" in a non-party speech, describing it as an experimental institution. Changing the metaphor, he spoke of it as a machine of unknown first cost and very questionable efficiency. The contact surfaces were rough, and the lubrication took the form of grit introduced into the bearings of the working parts by the parts that did no work. Mr. G. Croydon-Marks, M.P., replied. The president then read a telegram from the chairman of the Institution, Mr. Hunter, who was absent in Cairo, and proceeded to the toast of "Chemical Science," referring to his early training under Prof. Thorpe, which gave him the knowledge of chemistry which had been so useful to him as an engineer. Mr. Clerk referred to his epoch-making paper of 1882 before the Institution of Civil Engineers on the chemistry of the gas engine, and protested against the frequent suggestions that all advances in science came from abroad; there was no lack of technical training in this country, especially in chemistry. Prof. Thorpe replied, giving at great length his recollections of the young Dugald Clerk as an enthusiastic seeker after knowledge and a genius of the first order 35 years ago.

Prof. E. J. Mills proposed "The Junior Institution of Engineers," and also claimed to have appreciated Mr. Clerk 30 years ago. He congratulated the Institution on its progress, the membership approaching 1,000, and gently chaffed them about their billiards and dancing. In reply, Mr. F. S. Pilling, vice-chairman, explained the objects of the Institution, and the advantages derived from intercourse between those who had been abroad and those who were going, the promotion of discipline and culture, &c.

Finally, Mr. L. H. Rugg, vice-chairman, proposed the health of the President, coupled with the name of the internal combustion engine. The President replied, admitting that he was a Glasgow Highlander, and complaining that he was known as "the gas man." He corrected Mr. Rugg's too eulogistic references to the capabilities of the gas engine, and stated that he was engaged in adapting the gas engine to marine propulsion, having designed a compound reversible gas engine of 600 H.P. In 20 years, he said, large ships would be driven by gas engines, using only half the fuel required by steam engines. He concluded by giving the credit to the secretary, Mr. W. T. Dunn, which is his due, and proposed his health, and that of the Council. Mr. Dunn briefly replied, and the proceedings came to a close with "Auld Lang Syne."

During the evening Miss Mabel Marx, Mr. C. Morton, and Mr. P. L. Dunning sang, Mr. T. E. Gatehouse played violin solos, and Mr. C. Frood gave musical sketches.

Royal Institution.—Last Friday a lecture was given by Mr. W. C. D. Whetham on the "Passage of Electricity through Liquids."

I.E.E. (Glasgow Section).—The Committee has decided to form a Students' Section.

At Aberdeen on 16th inst., Mr. R. B. Greig, Fordyce Lecturer in Agriculture at the Aberdeen University, lectured on "Electricity and Plant Life."

The British Association meeting this year will be held at York, under the presidency of Prof. Ray Lancaster. The meeting will open on August 1st.

A lecture on "Faraday and Modern Electricity" was delivered at the University College, Nottingham, on 16th inst., by Mr. J. D. Coales, B.Sc.

"The Use of Electricity in Mining Operations" was discussed at

last week's meeting of the Manchester Geological Society. Mr. P. Barrett Coulston read a paper on the subject.

Correction.—In the first column on p. 319 of this issue, at the end of line 19, read "$\frac{1}{10}$d."

Appointments Vacant.—An open competitive examination for not fewer than 12 situations as assistant examiner in the Patent Office will be held by the Civil Service Commissioners in April next. The examination will commence on the 23rd inst., and forms of applications may be obtained on request addressed by letter to the Secretary, Civil Service Commission, Burlington Gardens, London, W.

The *Australian Mining Standard* says that the Federal Government has decided to create the position of chief electrical engineer of the Commonwealth Postal Department, and the Public Service Commissioner, Mr. M'Lachlan, is now engaged in drawing up the terms and conditions of the appointment. The salary provided on the estimates is £750 per year, and it is expected that several of the State electricians will be candidates for the position. One of the first subjects the new officer will be asked to devote his attention to will be the toll or measured-rate telephone system. Mr. Hesketh, the Queensland electrician, strongly recommended its adoption after seeing it in operation in America, and the chief electrical engineer will be requested to formulate a scheme to gradually introduce it into the central telephone exchanges of the several States.

Meter superintendent for Barking Town (£100); temporary electrical engineering assistant for Dublin electricity works; cable jointer for Handsworth.

Steam Generation by Low-Grade Fuels.—In a recent issue of the *Engineering Magazine*, Mr. W. F. Goodrich contributes an article dealing with the possibilities of low-grade fuel for steam generation. He points out that, in order to obtain a fair evaporative efficiency from a fuel containing over 30 per cent. of incombustible, the proper way is not to burn the fuel on an ordinary fire-grate, but in an external fire-brick cell. By the use of such a method it is possible to employ a fire-grate area which is quite impracticable under ordinary conditions. A Lancashire boiler, for instance, which usually has a grate area of, say, 38 sq. ft., might be provided with an external fire-brick cell having from 50 to 75 sq. ft. grate area; with this area, and artificial draught, it is possible to burn an inferior quality of fuel and obtain an evaporative efficiency from the boiler which under any other conditions could not possibly be obtained. In order to burn, say, 10 cwt. per hour of Welsh steam coal in a Lancashire boiler, a good natural draught and an unusually smart fireman are necessary. With an external cell, on the other hand, having, say, 50 sq. ft. of grate, 30 cwt. of pit bank waste could easily be fired per hour. Whilst this fuel may have only an evaporative efficiency of 4 lb. of water per lb. of fuel, it is possible, owing to the increased grate area, to evaporate more than 10,000 lb. of water from a Lancashire boiler measuring 30 ft. × 8 ft. The use of forced draught Mr. Goodrich considers to be essential, it having been demonstrated that induced draught is quite unsuitable for the purpose.

Touching on the smoke question, Mr. Goodrich appears to be in entire agreement with the views frequently expressed by Mr. W. H. Booth in these columns, namely, that it is impossible to obtain smokeless combustion from very low grade fuels containing a high percentage of volatile matter, unless the fuel has "a common-sense environment" in the shape of an incandescent firebrick cell.

In reply to the argument that the large mass of firebrick absorbs a considerable quantity of heat, Mr. Goodrich contends that the actual heat value absorbed by the brickwork is recouped again and again by the rapid ignition of gases, and the intense and well sustained temperature of the gases passing into the boiler, and as to the fear that such a cell would be costly in maintenance and upkeep, this, the author maintains, is purely a question of design. If properly constructed and designed such a furnace will, he says, cost no more for maintenance than is often cheerfully paid by steam users for fire-bars alone. Mr. Goodrich gives some data as to the burning of peat fuel; and considers that if this fuel were burned in an external firebrick cell no difficulty would be experienced in obtaining a boiler efficiency equivalent to modern practice with the best steam coal.

Touching on the question of mechanical stokers, the author does not think that they have yet obtained that state of perfection which is so persistently claimed for them by their makers; but agrees that very considerable progress has been made during the last 10 years. Ten years ago, in order to work a coking stoker smokelessly, it was necessary to reduce the output of the boiler to about one-half its rated capacity, namely, from 3,000 to 4,000 lb. of water evaporated per hour for a boiler 30 ft. × 8 ft. Nowadays the same sized boiler, fitted with coking stokers and forced draught will, with the same quality of fuel, evaporate from 12,000 to 14,000 lb. whilst preserving a clean chimney. Even higher outputs than this can be obtained with sprinkling stokers and artificial draught, but not with an entire freedom from smoke. For smokeless combustion the author is of opinion that the coking stoker is essential. Still, the range of usefulness of mechanical stoking is limited. Such fuels as town's refuse, peat, wood, pan breeze, coke breeze, colliery waste, and the lowest grades of fuel cannot be dealt with by mechanical stokers, and the author's opinion is that town's refuse never will be successfully dealt with by any system of mechanical firing.

The Cost of Electrical Nitric Acid.—Calculations have recently been published in some of the French papers which tend to make it appear impossible for nitric acid synthesised electrically, according to the Birkeland and Eyde process, to compete with ammonium sulphate as a fertiliser, or otherwise. Based on the claims in the inventors' patent specification, it is said that the yield of the Birkeland-Eyde process, in terms of 100 per cent. nitric acid, is 650 kg. per KW.-year, *i.e.*, the metric ton per 1·5 KW.-years. The cost of developing electrical current from water power, that is to say, the expenses of attending to and lubricating the machinery, come to 2·48 centimes at Christiania, and to 3·20 centimes at Niagara Falls, per KW.-hour; whence the mean cost per year of 8,000 hours for 1·5 kilowatts is shown to be 340·80 fr. But that sum is more than the present English selling price (£11 or £12, 275 to 300 fr. per ton) of ammonium sulphate.

Nitric acid of 100 per cent. strength contains about 22 per cent., and pure ammonium sulphate about 21 per cent. of combined nitrogen, so that for general purposes it is fair to compare the expenses of making equal weights of the two materials. Hence writers would seem to be correct in representing, on the above described basis, that the substances cannot compete, and will not be able to do so unless the cost of generating electrical energy from water-power can be greatly reduced. It is only right to say that a possibility of competition might be also ensured if the yield of the electrical manufacturing process were greater. The figure we have given above is low; it is much lower than that quoted by Boileau a few months ago (see ELECTRICAL REVIEW for December 8th, 1905, p. 923). Boileau states that the output of a Birkeland apparatus is equal to 900 kg. per KW.-year; whence, using the foregoing data, the cost of the energy per metric ton is only 253 fr. Probably this figure is still a good deal too high to permit of commercial rivalry between the substances, except when heavy charges for freight come in; but at any rate it indicates that our tar friends might wait until we do know the cost of electrically combined nitrogen before they are so certain of their invulnerability.

Submarine Telegraphy.—Mr. Charles Bright, F.R.S.E., gave a lecture at the Royal Military School, Chatham, on the 9th inst., under the auspices of the Royal Engineers, the subject being "Submarine Telegraphy." In the course of his lecture, fully illustrated by lantern slides, Mr. Bright described the methods of transmitting electrical signals through cables, and mentioned that nowadays the speed of working was only limited by the type of cable in accordance with traffic requirements, thus showing that wireless telegraphy for commercial purposes had a considerable task ahead before it could compete successfully with cables. He then went on to describe the various stages of construction in a cable, from the copper conductor and insulator to the iron sheathing. The methods of surveying the ocean, of laying the cable and providing for irregularities of the bottom, including the landing of the shore-ends, were next dealt with; as also of picking up and repairing when required owing to a fault occurring subsequently, this being discovered and localised by means of electrical tests. The telegraph fleet of some 50 vessels was then alluded to, as well as the cable-testing hut and signalling stations and instruments throughout the world. A *résumé* of submarine cable work from the very commencement was then given, with portraits of the pioneers. After showing a map of the world's cables up to date, Mr. Bright gave a few interesting statistics. It appears that there are some 225,000 miles of cable in all at the bottom of the sea, representing 50 millions sterling, each line costing about £200 per mile to make and lay. The average useful life of a cable nowadays may be anything between 30 and 40 years according to circumstances. About six million messages are conveyed by the world's cables throughout the year, or 15,000 a day, the working speed for any one cable being up to 100 words per minute under present conditions. About 90 per cent. of these are sent in code or cipher for business and official purposes. The social, political and strategic importance of cables was then discussed, as well as the tariffs which, in the case of the Atlantic lines (of which there are 15) have been reduced from an initial £1 a word to the present day 1s. a word. There are, however, it would seem, still some tariffs ranging over 7s. a word.

With reference to the strategic value of cables, Mr. Bright mentioned that a battleship, costing a million of money, was wasted if not in the proper position at a critical moment, owing to the lack of cable communication. This cost was, perhaps, great—under the circumstances—compared with that, for instance, of an Atlantic cable costing half a million, but, as Mr. Bright pointed out, the two are necessities of the age; and, as he further suggested, we may some day find it so, with a Government bereft of national and Imperial interests.

Fatality Claim.—A claim in respect of the accidental death of Mr. Alexander D. Melville, an engineer in the employment of the British Westinghouse Manufacturing Co., Ltd., which occurred in Stirling Road electric sub-station on December 27th last, has been lodged with the Electricity Committee of the Glasgow T.C. The Committee, having heard the town clerk with regard to the matter, instructed him to repudiate liability for the claim.

What is an "Electrician"?—The following appeared in the *Birmingham Daily Post* of February 14th:—

ELECTRICIAN Wanted, beginning of March, must be used to oil engine, repairs, pumps, &c., and good plain carpenter, fill in odd time indoors or out; married, no family; light employment for wife; comfortable home. Salary £40 a year to start with.—H. C. Potts, Llanyre Hall, Llandrindod Wells.

Gas.—Three persons were injured by a gas explosion at Pontypool on 15th inst. A fitter employed by the Pontypool Electric Light Co. was seeking a fault at the time, and when the culvert was being opened the explosion occurred. At Greenwich on 17th inst., while gas fitters were at work tracing a leakage in the roadway, a serious explosion occurred in a house into which the gas had found its way. The premises were set on fire and wrecked, and four persons were injured.

Admiralty Electrical Appointments.—The *Times* states that the Admiralty have decided that the subordinate supervising staff for the Electrical Engineers' Department at Sheerness Dockyard is to consist of an assistant electrical engineer-in-charge, at a salary of £300 on appointment under the non-pensionable scale, and £250 on appointment (if promoted from inspector of electrical fitters) under the pensionable scale, and two inspectors of electrical fitters. The assistant electrical engineer is to be in lieu of the electrical engineer (Mr. Z. H. Kingdon), who has been selected for service at the Admiralty. The drawing staff of the department is to consist of a second-class draughtsman and two mechanics on drawing duties, and the writing staff of a first-class and a hired writer.

Cape Town Electrical Contractors.—The Cape Town and District Electrical Contractors' Association met recently at Cape Town and elected Mr. W. B. Phelp, of the British General Electric Co., Ltd., as its president. The meeting considered a circular recently issued by Mr. Long, the city electrical engineer, forbidding, from January 1st, 1906, the use of Simplex tubing under plaster. Nearly all the leading firms of Cape Town have joined the Association. Mr. C. G. Trevett is the hon. secretary.

Postal Service Inquiry.—In the House of Commons, on 20th inst., the Postmaster-General said he had come to the conclusion that further inquiry was necessary into the position of the principal classes of postal servants. The Government had therefore decided to appoint a Select Committee of the House of Commons to inquire into the question of the adequacy or otherwise of their remuneration, having regard to the conditions and prospects of their employment, with a view to the settlement of the question. The inquiry could not be extended to every class in the service.

The P. & O. Batti Wallahs.—In a recent issue we announced a proposed meeting of electricians who had served in the Peninsular and Oriental Steam Navigation Co.'s mail steamers. We now learn that as a result of this meeting it has been decided to hold the first annual dinner of members and their friends at the Holborn Restaurant on Saturday, March 10th, at 6.30 o'clock. Thirty-six members, all former P. & O. electricians, have already joined the society, which will be known as the P. & O. Batti Wallahs Society, and the hon. secretary, Mr. E. Sheppard, of 20, Buckersbury, E.C., will be pleased to hear from any other gentlemen who have not been enrolled.

French Import Duties.—It is reported that the French electrical firms have caused representations to be made to the Government on their behalf with a view to the introduction of a large increase in the import duties, namely, from 24s. to 30s. per cwt. to 96s. per cwt. The suggested advance would affect apparatus for heavy currents, telegraph and telephone apparatus, and measuring and registering instruments. The report to this effect emanates from German sources, which point out that if the increase were enforced it would detrimentally affect the exports to France from England, Switzerland, Germany, Austria and the United States, and that the desire for higher duties represents a retrogression in the capabilities of the French electrical manufacturing industry.

Mackay Cable Companies.—A Reuter's dispatch from New York says that the annual report of the trustees of the Mackay Companies was issued on 15th inst. The companies now own part or all of the capital stock of 74 prosperous cable, telephone and telegraph companies in the United States, Canada and Europe, including the commercial cable and postal telegraph systems. The Mackay companies are one of the largest stockholders in the American Telephone and Telegraph Co., commonly known as the Bell Telephone Co., and during the past year they have acquired the control of the North American Telegraph Co., which for 20 years has owned and worked the telegraph system in Minnesota, Wisconsin, Iowa and Illinois. The report shows that the Mackay companies have no debts, and that they hold $40,645,600 preferred and $41,330,400 common stock. The laying of the fifth cable in the Atlantic Ocean, the establishment of cable communication with Newfoundland, and the laying of new cables to Japan and China are referred to in the report.

A Thirty Years' Celebration.—On Wednesday evening last week, Messrs. W. F. Dennis & Co. gave a dinner at the Holborn Restaurant, the occasion being the celebration of the thirtieth anniversary with the firm of the senior partner, Mr. F. A. B. Lord, who joined the late Mr. W. F. Dennis in 1876. Covers were laid for 114, and Mr. Lord occupied the chair.

After the usual loyal toasts, proposed by the chairman, had been honoured, the toast of the evening, that of "The Chairman," was proposed as a four-part pæan in his praise, by Mr. W. T. Spoerer, of Messrs. Felten & Guilleaume, Mülheim, Director, R. B. Bumiller, of the Antwerp Telephone and Electrical Works, Mr. W. W. Rogers, of Felten & Guilleame, Cologne, and Mr. McLachlan, of Messrs. Dennis & Co. Accompanying the song of triumph came peace offerings from the quartet named, consisting of solid silver bowls, cigarette box, ash tray, rose bowl and a drawing room clock; and Mr. E. J. Reid presented Mr. Lord with a gold penknife as a personal souvenir.

The chairman, in reply, said:—"A boy was wanted in the City, and eventually on February 14th, 1876, I entered the employ of Mr. F. W. Dennis. At this time, as some here will remember, the business consisted principally in dealing in old metals, an agency for Middlesbrough pig-iron, and a roving commission for Henley's, who then had in full working the large rolling mills and wire-drawing plant at North Woolwich and South Wales. The turning point of our career took place in 1877. The great works of Henley's were silent, and F. W. Dennis, with an insight which was remarkable, took over the representation of Messrs. Felten & Guilleaume for wire, and E. Bocking & Co. for wire rods, and I well remember soon after the great delight with which an order for 100 tons of galvanised wire was hailed from a firm who have long since given up making strand. Time will not permit me to go into all the details of how we have won the position we hold to-day. At the basis and foundation of all, the names of two men stand for all time—I mean Mr. Emil Guilleaume and Mr. W. F. Dennis. With such a combination of energy, initiative and technical knowledge success was assured from the first. It was in such a school as this that I caught to some extent the spirit and energy and enthusiasm of the late W. F. Dennis, and, after a few years, on moving into larger offices at 101, Leadenhall Street, he gave me the choice of being either his confidential clerk or a traveller; and as he strongly advised me to get outside, I did so, and just then barbed wire was invented, which gave me a good lift, and many friends who are sitting round this table to-night I came into contact with through that pretty article, and this was another turning point in my career. About this time (1880) we also started making our own wire netting, but eventually found it very difficult to run an agency and a manufacturing business, and so sold the machines, which some of my friends will understand I should very much like to have just now, with such good discounts ruling. This sale however, was not the end of netting machines or wire netting. Looking back, one can only wish that it had been, for there is little doubt that the Dennis patent continuous wire-netting machines, on which a large amount of time and money was spent, and the litigation over an Australian shipment of wire netting, largely led to the great calamity which overwhelmed us in December, 1889, when W. F. Dennis passed away at the early age of 44, and in the prime of life amid the regret and esteem of all his friends. I would remind you that just at this time the wonderful age of electricity was beginning, but even then barbed wire was selling at £40 per ton; lead-covered cables were not heard of, and telephones were a novelty which few believed in. Three-ply strand iron-wire was used for the overhead conductors, and the general public had not the luxury of wiping their feet on spiralium wire mats. The next few years were years of quiet progress, and during this period we were fortunate in securing another agency, viz., the Antwerp Telephone Electrical Works, managed so ably by Rod. B. Bumiller. This agency enabled us to complete the connection from mouth to ear though many miles apart. During this time we also had been representing the firm of Felten & Guilleaume, Cologne, amongst export buyers in conjunction with W. W. Rogers for the Home Trade for the sale of hemp twines, cords, string, &c. Another 13 years rolled by, and we come to the year 1902, when another calamity befel our firm by the death of Mr. A. Dennis, senior partner, but once more we found the good foundation come to our aid, and with the able assistance of an excellent staff we were able still to hold our own. The late W. F. Dennis's son and heir, who sits opposite me in the vice-chair, became a partner. In these few words you have a brief sketch of the history of W. F. Dennis & Co., which is, in fact, the history of my career. We have taken counsel of those who knew better than we; we have been careful in management and industrious in looking after orders; whether we have always had the requisite ability and strength to oppose the fearful competition is not for me to say, but at any rate, we have tried to direct our energy into those channels which bring the best results and win victory for our principals as well as for ourselves."

Other toasts, such as "Our Clientèle," proposed by Mr. Dennis, to which four gentlemen responded; "Our Confrères," with five responses, one *confrère* reading a reply, which seemed to us to take at least a quarter of an hour to get through, found the drawing room clock pointing to 11.35, at which early hour we had to depart to catch our last train. The musical programme, which consisted of some 15 or 16 items, might well have been dispensed with for everybody wanted to make speeches, and when we retired from the scene of revelry some 10 songs and instrumental pieces remained unplayed and unsung.

Mr. York Bowen, one of the most brilliant and promising of English composer-executants, played Chopin's "Scherzo in B minor" upon one of Messrs. Chappell's special "Grands," to an audience that seemed strangely lacking in appreciation of the great Polish master and his admirable interpreter, but which showed itself quick enough to grasp the points of Mr. Fred Rome's comic song "Who's Who." Mr. York Bowen, for whom we felt much sympathy, and who, we hope, took everything as merely an "*Episode de la vie d'un Artiste*," should have played a second piece, a "Caprice" of his own composition, but he had to leave it *sine die*, the musical programme having got quite out of hand. The main function, however, was most interesting from a social point of view, and Mr. Lord was no doubt highly gratified at finding so large a number of friends foregathered to do him honour.

Post Office Dinner.—The third annual dinner of the London Post Office Engineering Department was held on Tuesday evening, February 13th, at the Hotel Cecil, Mr. John Gavey, C.B., M.I.C.E., Engineer-in-Chief of the Post Office and President of the Institution of Electrical Engineers, presiding.

The guests of the evening included the Right Hon. Sydney Buxton, M.P., Postmaster-General; Mr. H. Babington Smith, C.B., C.S.I., secretary; Mr. J. Ardron, Sir Robert Hunter, Mr. S. C. Hooley, Mr. T. R. Baillie Gage, Mr. A. J. M. Ogilvie, Sir W. H. Preece, Major Boys, R.E., D.S.O., Mr. A. W. Heaviside, Dr. Walmesley, Mr. H. Ogden, Mr. G. Morgan, Mr. J. W. Willmot, Mr. H. F. Preston, and Mr. W. J. Etheridge.

After the Royal toasts had been duly honoured, Mr. H. Babington Smith referred to the successful conclusion of an agreement to purchase the National Telephone Co.'s system on January 1st, 1912, and to the proposed formation of the Institution of Post Office Electrical Engineers, assisted by a grant from the Treasury, and proposed the toast of "The Engineering Department of the Post Office." Mr. Gavey, in his reply, announced that the underground telegraph line to Glasgow was completed, and would be opened on or after April 1st. In the course of the present year a similar line to Chatham would be finished, and one to Reading begun. The great telegraph switch for intercommunication throughout the Metropolitan area had been completed, and 10,000 new telephone stations had been joined up in London. In conclusion, he congratulated the staff on the formation of the new Institution.

Mr. Harrison having briefly proposed the health of "The Visitors," Mr. Sydney Buxton, Postmaster-General, regretted that he could not be an engineer, though he was a "well-wisher," and expressed his surprise to find what a marvellous machine was composed of the Postal Institutions, of which he had no previous knowledge. He objected to telegraph poles and wires, as he preferred Nature unadorned.

Sir Robert Hunter proposed the health of Sir W. H. Preece, who, in reply, expressed the pride and pleasure with which he looked back upon the years he spent in the Post Office.

During the dinner music was provided by the Hambleton Bijou Ladies' Orchestra, and an excellent programme was performed under the direction of Mr. E. J. Wood, the artistes including Mr. F. Robins, Miss Annie Bartle, Mrs. Kate Firminger, and Messrs. Cockburn, Emlyn and Churcher.

Niagara Falls.—A Reuter dispatch from Ottawa says that the Board of Trade has passed a resolution asking the Government to forbid any arrangements that may interfere with the right of Canada to develop the water power of Niagara, and favouring legislation to prohibit the producers of electric power in Canada from transmitting the same to the United States, except under contracts terminable in five years.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—On Thursday evening 15th inst., the staff and employès of the Ealing Corporation Electricity Department, held their second smoking concert at the Electricity Works. The chair was taken by Mr. J. Douglas Knight, borough electrical engineer.

Mr. E. W. Dickinson, who has temporarily occupied the position of superintendent at the Greenwich Power Station of the L.C.C. tramways since November, 1904, is now proposed to be promoted to the permanent staff as station superintendent at a commencing salary of £350 a year, rising by annual increments of £25 to £400.

The resignation of Mr. J. H. F. Bale, the electrical engineer and tramways manager, and Mr. W. H. Wilkinson, inspector, have been accepted by the Walthamstow U.D.C. Testimonials under seal are to be given to both officers.

Mr. J. E. Bridgman, a charge engineer at Hanley electricity works, has resigned his position, and has taken up an appointment as charge engineer at the Tame Valley Works of the Stalybridge, Mossley, Dukinfield and Hyde Joint Electricity Board under Mr. Blackmore, the Board's chief engineer.

The Electric Power Committee of the Devonport Corporation has again decided to recommend the Council to increase the salary of the electrical engineer, Mr. J. W. Spark, from £275 to £300 a year.

The Middlesbrough T.C., by 16 votes to 10, decided that only the bonus of £50 should be paid to the electrical engineer, Mr. H. M. Taylor, and that his salary should not be increased by £50 per annum to £450. The bonus is in respect of additional duties in connection with recent extensions.

The Leigh (Lancs.) T.C. has increased the salary of Mr. A. T. Smith, electrical engineer, from £250 to £270 per annum.

On February 14th, at St. Mary's, Hampstead, N.W., Mr. R. A. Chattock, city electrical engineer of Birmingham, was married to Clara Valentine Sisson, youngest daughter of Mr. Joseph Sisson, of Penrith, Cumberland.

Tramway Officials.—Mr. Alex. Walton, inspector to the Falkirk and District Electric Tramway Co., has been promoted to the position of chief inspector in succession to Mr. D McConomy, who has received an appointment in Motherwell.

In connection with the decision of Croydon Borough Council to take over the entire control of its tramways, the question of managership came up for discussion on Monday night. The Tramways Committee recommended the appointment of Mr. T. B. Goodyer with a salary of £600 per annum. He has been the manager for the lessees, the B.E.T. Co., during the whole time they have been in Croydon, and whose tenure closes on May 31st. It was recommended that Mr. Goodyer should have entire charge of the working, with the exception of any responsibility as to the upkeep of rails or track, this being left to the borough road surveyor (Mr. E. F. Morgan). Councillor Stapleton, moving the report, said the Committee at first thought of advertising for a manager at £500, but, after closely going into the matter, felt that the exceptional local knowledge and business ability of Mr. Goodyer justified them in recommending him at £100 extra. Opposition to the Committee's recommendations, it may here be stated, had been foreshadowed, and Alderman Trumble moved that they be referred back. However, before he had disclosed his full reasons, the debate was peremptorily adjourned till next Monday under the Council's time-limit rule. It is understood that the policy of not advertising the appointment is to be criticised.

General.—Mr. W. A. Scott and Mr. John Leggat have opened offices at 102, St. Mary Street, Cardiff, where they are practising under the name Scott & Leggat as consulting engineers in collieries, steel works, and engineering works generally. We understand that Mr. Scott has been for 15 years with Messrs. Ernest Scott & Mountain, and has been resident engineer for them in South Wales during the past five years, where he has been responsible for the carrying out of several large installations in collieries and steel works. Mr. John Leggat has been chief designer to Messrs. Ernest Scott & Mountain for the past five years. Messrs. Scott & Leggat are acting in Wales for Mr. P. J. Mitchell, of London, who owns the Rateau exhaust steam utilisation patents, for the utilisation of the exhaust steam from colliery winders and steel works plant.

The Bradford Technical College is losing the services of Prof. H. Bohle, who for the last three years has occupied the position of Lecturer in Electrical Engineering at the College, and has recently been appointed to the newly-instituted Chair of Electro-Technics at the Cape Town University. Prof. Bohle, who is leaving Bradford immediately to take up his new position, has been entertained to supper by his colleagues on the staff and presented with six volumes of Prof. Arnold's works as a parting gift.

Mr. W. Austen Goodman, of Kandy, Ceylon, was married on February 7th at Colombo to Miss E. M. Church, of Bowdon, Cheshire. Mr. Goodman for the past six years has held an important position with Messrs. Walker, Sons & Co., of London and Colombo, and for some years previous to leaving England was with the Edison & Swan U.E.L. Co., Ltd., at their Broadheath Works, Manchester.

NEW COMPANIES REGISTERED.

Anglo-Mexican Electric Co., Ltd. (87,403).—This company was registered on January 27th, with a capital of £300,000 in £1 shares, to acquire any concessions for the utilisation of water power, for the generation and distribution of electricity, for electric lighting, hydraulic or electric power supply, or for tramways, railways or other public works in Mexico or elsewhere, to erect, construct and maintain reservoirs, dams, canals, power stations, mains and distributing plant and machinery, and to carry on the business of suppliers of electric light and power, manufacturers of motors, generators, converters, meters, lamps, materials and batteries, suppliers of hydraulic power, &c. The first subscribers (each with one share) are:—J. Tanner, Newton House, Ravenna Road, Putney, cashier; E. Andrews, Percy House, Almeric Road, Clapham Common, S.W., incorporated accountant; C. J. Newman, 130, Loughborough Park, S.W., accountant; W. P. Devine, 6, Ethelden Road, Shepherd's Bush, W., private secretary; W. R. Bignall, 10, Grove Terrace, Squire's Lane, Finchley, N., clerk; J. Baker, 53, Seward Road, Hanwell, W., clerk; and C. Reed, Elm Tree Villa, Rosenau Road, Battersea Park, S.W., clerk. No initial public issue. The number of directors is to be not less than three nor more than seven; the first are S. Mackew, 34, Bruton Street, W.; R. M. Bird, 66, Ashley Gardens, S.W.; and J. H. Macdonald, 31, Twyford Mansions, Weymouth Street, S.W. Qualification (except first directors), £500; remuneration (except managing director) as fixed by the company. Registered office, 35, Great St. Helens, E.C.

Electrocars, Ltd. (87,418).—This company was registered on January 29th, with a capital of £8,000 in £1 shares, to adopt an agreement with W. N. Stewart for the acquisition of certain inventions for improvements in (1) the mounting or supporting of electrical motors on electrically-propelled vehicles, and (2) the control of electric motors used in connection with secondary or storage batteries, to develop and turn to account the said inventions, and to carry on the business of manufacturers of electric accumulators, motors, controllers and vehicles and dynamos of all kinds, electricians, engineers, producers and suppliers of electricity, motive power and light, &c. The first subscribers (each with one share) are:—W. N. Stewart, 51, Ballater Road, Acre Lane, Brixton, S.W., engineer; A. R. Baird, Alderman's House, Bishopsgate Street, E.C., merchant; B. W. Parker, 12, Charles Street, Albert Gate, S.W., gentleman; W. R. Riddell, 7, Albion Road, Clapham, S.W., incorporated accountant; F. O. Swann, 6, East India Avenue, E.C., solicitor; J. Warren, 63, Camberwell Grove, S.E., clerk; and T. J. M. Hume, 3, Beechwood Road, Hornsey, clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the first are W. N. Stewart (permanent), A. R. Baird and B. W. Parker; qualification, 200 shares; remuneration, £100 each per annum, and 5 per cent. of the net profits remaining after 10 per cent. dividend is paid (such commission not to exceed £500 in any one year). Registered office, Alderman's House, Alderman's Walk, Bishopsgate Street, E.C.

New Electric Rifle and Target Co., Ltd. (87,477).—This company was registered on February 2nd, with a capital of £16,000 in £1 shares (6,277 "A," 5,600 "B" and 4,123 "C"), to acquire the undertaking of the Auto-Electric Rifle and Target Co., Ltd. (incorporated in 1903), to adopt an agreement between R. J. Combin (for the vendor company) and J. G. Main (for this company), and to carry on the business of manufacturers of and dealers in auto-electric rifles, targets and target apparatus of all kinds. The first subscribers (each with one "A" share) are:—C. Baker, 85, Gresham Street, E.C., solicitor; J. G. Main, 103, Malmesbury Road, Bow, E., clerk; A. J. Lovelace, 85, Gresham Street, E.C., solicitor; W. E. Batt, 85, Gresham Street, E.C., solicitor; W. J. Webber, 57, Camberwell New Road, S.E., clerk; P. H. Godwin, 12, Stayton Street, Chelsea, clerk; and R. G. Combin, 96, Upper Tulse Hill, S.W., articled clerk. No initial public issue. The number of directors is to be not less than two nor more than seven; the first are A. Moul, E. Daoust, D. Winder and W. Firth; qualification, £200; remuneration, £50 each per annum (chairman £25 extra) and 10 per cent. of the surplus profits remaining after payment of 10 per cent. on the "A," 7 per cent. on the "B" shares, and 5 per cent. on the "C" shares. If any surplus remains after the said fixed dividends and remuneration have been paid, the "A" shares shall receive half, the "B" shares one-third, and the "C" shares one-sixth thereof.

Tweedales & Smalley, Ltd. (87,450).—This company was registered on January 31st, with a capital of £210,000 in £10 shares, to take over as a going concern the business carried on at Castleton, near Manchester, by E. Tweedale, S. Tweedale and J. Smalley, under the style of Tweedales and Smalley, and to carry on the business of cotton machinery makers, machinists, ironmasters, founders, general engineers, agricultural implements manufacturers, coppersmiths, electricians, suppliers of electricity for all purposes, builders of electric cars, tramcars and other vehicles and rolling stock, &c. The first subscribers (each with one share) are:—Edmund Tweedale, High Birch, Rochdale, machine maker; S. Tweedale, Sautridge House, Castleton, Lancs., machine maker; J. Smalley, Norton Grange, Castleton, Lancs., machine maker; J. T. Tweedale, 3, Vicarage Road, Castleton, Lancs., machine works manager; W. Tweedale, Armcliffe, Rochdale, machine works manager; J. Tweedale, High Birch, Rochdale, salesman; R. B. Smalley, Norton Grange, Castleton, Lancs., salesman; Ernest Tweedale, Sautridge House, Castleton, Lancs., engineer; E. Smalley, Norton Grange, Castleton, Lancs., machine fitter; J. E. Tweedale, High Birth, Rochdale, machine fitter; W. Smalley, Norton Grange, Castleton, Lancs., machine fitter; L. Tweedale, Sautridge House, Castleton, Lancs., machine fitter; and F. Tweedale, High Birch, Rochdale, medical student. No initial public issue. E. Tweedale, S. Tweedale and J. Smalley are permanent governing directors, subject in each case to holding £10,000 shares; remuneration, £1,040 each per annum. Registered office, Castleton, Lancs.

Dynamic Syndicate, Ltd. (87,473).—This company was registered on February 2nd, with a capital of £12,300 in 1,200 5 per cent. cumulative preference shares of £10 each and 6,000 ordinary shares of 1s. each, to acquire any patents and inventions relating to the production, treatment, storage, application, distribution and use of electricity, and to carry on the business of suppliers of electric light and power, electricians, mechanical engineers, garage keepers, manufacturers of electric cars and vehicles, &c. The first subscribers (each with one ordinary share) are:—F. Minton, 7, New Square, Lincoln's Inn, W.C., solicitor; A. C. Goodlet, 20, Copthall Avenue, E.C., chartered secretary; J. Green, 52, West End Avenue, Leyton, engineer; J. K. Goodlet, 3, Hurst Road, Walthamstow, mechanic; D. H. Allen, 20, Copthall Avenue, E.C., chartered accountant; H. Gilson, 8, Great St. Helens, E.C., solicitor; and W. Eacott, 29, Powell Road, Clapton, N.E., gentleman. No initial public issue. The number of directors is to be not less than three nor more than seven; the first are D. H. Allan, A. Goodlet and J. Green; qualification, 100 shares; remuneration (except managing director's) as fixed by the company. Registered office, 6, Broad Street Place, E.C.

Zircon Syndicate, Ltd. (87,466).—This company was registered on February 1st, with a capital of £2,000 in £1 shares (sub-division not shown), to deal in, manufacture, sell, exploit, distribute and apply incandescent and electric lamps of all kinds, &c., and to adopt an agreement with the International Dowsing Electric Heating and Appliances Co., Ltd. The first subscribers (each with one share) are:—W. Conolly, 10, Eastcheap, E.C., gentleman; E. N. Adler, 15, Copthall Avenue, E.C., solicitor; E. S. M. Perowne, 15, Copthall Avenue, E.C., solicitor; H. J. Dowsing, 24, Budge Row, E.C., electrical engineer; A. R. Norbert, 24, Budge Row, E.C., director; D. Huntley, 70, Loveday Road, West Ealing, electrical engineer; and G. F. Stevens, 3, Chipley Street, New Cross, S.E., accountant. No initial public issue. The number of directors is to be not less than two nor more than five; the subscribers are to appoint the first; qualification, 50 shares. Registered office, 24, Budge Row, E.C.

Bettws-y-coed Electric Lighting Co., Ltd. (87,552).—This company was registered on February 10th, with a capital of £5,000 in £1 shares, to acquire from the Urban District Council of Bettwsycoed the Bettwsycoed Electric Lighting Provisional Order, 1906, to adopt an agreement with R. Conway, H. W. Lance, O. I. Jones, R. V. Johnson, Ann Evans, Kate Pullen, R. Parry, H. Roberts, R. Rowlinson, S. London, T. W. Evans, O. L. Jones, A. Davies and E. B. Smith, and to carry on the business of an electricity supply company, electric and mechanical engineers, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic and other appliances and apparatus, &c. The first subscribers are:—R. Conway, 112, Mostyn Street, Llandudno, hotel proprietor, 50 shares; S. London, Miners Bridge House, Bettwsycoed, quarry manager, 50 shares; R. V. Johnson, Llanrwst, solicitor, 1 share; H. W. Lance, 9, Ludno Street, Llandudno, electrical engineer, 1 share; O. I. Jones, Plasyndre, Llanrwst, gentleman, 1 share; B. H. Pullen, Royal Oak Hotel, Llandudno, assistant manager, 1 share; A. Davies, Maelgwyn House, Bettwsycoed, inspector, 1 share; H. Holmshaw, Bettwsycoed, retired organ builder, 1 share; and E. B. Smith, Oswestry, engineer, 1 share. Minimum cash subscription 25 per cent. of the shares offered to the public. The number of directors is to be not less than two nor more than seven; the first are R. Conway and S. London; qualification, £50. Registered office, Miners Bridge House, Bettwsycoed, Carnarvon.

Electrical Improvements, Ltd. (87,499).—This company was registered on February 5th, with a capital of £2,000 in £1 shares, to acquire certain inventions relating to improved methods of electrically turning on and lighting up street and other gas lamps, to acquire from W. Pare certain patents relating to the said inventions, and to carry on the business of electricians, mechanical and general engineers, producers and suppliers of electricity, motive power and light, &c. The first subscribers (each with one share) are:—J. Pycroft, 235, Woodborough Road, Nottingham, machine builder; L. Pycroft, 235, Woodborough Road, Nottingham, mechanic; G. A. Brewin, Victory Road, Beeston, clerk; I. Robinson, 118, Sneinton Dale, Nottingham, cashier; A. E. Hacking, 22, Highfield Road, West Bridgford, electrical engineer; L. B. Codd, Standard Works, Dame Agnes Street, Nottingham, electrical engineer; and R. H. L. Moll, Milton Chambers, Nottingham, solicitor. No initial public issue. Table "A" mainly applies. Registered office, 44, Parliament Street, Nottingham.

Tramways Construction Syndicate, Ltd. (87,507).—This company was registered on February 5th, with a capital of £5,000 in £1 shares, to construct, improve, work, lease or control electric, steam and other tramways and railways, motor-buses, motors and electrical storage, power and lighting works in any part of the world, and to carry on the business of carriers of passengers and goods, electrical engineers, electricians, contractors, manufacturers of and dealers in tramway, railway, motor, electric, magnetic, galvanic and other apparatus, &c. The first subscribers (each with one share) are:—E. D. C. Lord, 258, Kingston Road, Merton, gentleman; J. F. Butler, 22, Staines Road, Ilford, clerk; H. Howes, 16, Kingswood Road, Merton Park, Wimbledon, accountant; W. E. Sammes, 41, Brittania Road, Ilford, accountant; A. R. Butler, 22, Staines Road, Ilford, nurseryman; H. G. Nicholson, 22, Savoy Court, W.C., engineer; and R. S. Ellis, II, Saville Row, W., law student. No initial public issue. The number of directors is not to be less than three nor more than nine; the subscribers are to appoint the first; qualification, £10; remuneration, £100 per annum divisible. Registered office, 22, Staines Road, Ilford.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Prometheus Co., Ltd., Kingston (74,889).—A memorandum of satisfaction in full of a debenture, dated November 7th, 1903, securing £250, has been filed.

China and Japan Telephone and Electric Co., Ltd. (17,831). Issue, on January 24th, of a £500 7 per cent. debenture, part of series created November 28th, 1905, to secure £50,000, charged on the company's undertaking and property, present and future. No trustees. Previously issued of same series: £12,000.

Bath Electric Tramways, Ltd. (74,278).—A trust deed, dated December 28th, 1905, securing £7,000 first mortgage debenture stock (supplemental to a trust deed dated December 6th, 1904), has been registered. Property charged: The further undertaking of the company authorised by the Bath Electric Tramways (Light Railway Extensions) Order, 1905, and all permanent ways, stations, car-sheds, depôts, rolling stock, plant and machinery used in connection therewith. Trustees: Sir Frederick L. Robinson, 14, Observatory Gardens, Campden Hill, W.; and H. P. Strugis, "Givons," Leatherhead, Surrey. The trust deed also constitutes further security for £135,000 like stock secured by the principal trust deed.

Electric Light and Power Co. of Japan, Ltd. (60,811).—This company's annual return was filed on January 16th, when seven shares had been taken up out of a nominal capital of £3,000 in £1 shares, and £7 had been received. Mortgages and charges: Nil.

Burmah Electric Works Syndicate, Ltd. (63,563).—This company's annual return was filed on January 13th, when the entire capital of £2,000 in £1 shares had been taken up out of a nominal capital of £2,000 in £1 shares. 6s. 1½d. per share has been called up, resulting in the receipt of £615. Mortgages and charges: Nil.

Perth Electric Lighting Co., Ltd. (55,898).—This company's annual return was filed on January 30th, when 7 shares had been taken up out of a nominal capital of £1,000 in £1 shares. Nothing has been called up. Mortgages and charges: Nil.

Conduit and Insulation, Ltd. (50,527).—This company's annual return was filed on January 3rd, when 33,878 shares had been taken up out of a nominal capital of £40,000 in £1 shares. £1 per share has been called up on 15,878, including 7 forfeited, and £15,878 has been received. £18,000 is considered as paid on the remainder. Mortgages and charges: Nil.

Douglas Southern Electric Tramways, Ltd.—This company's annual return was filed on January 31st, when 25,978 preference and 15,472 ordinary shares had been taken up out of a nominal capital of £50,000 in 30,000 preference and 20,000 ordinary shares of £1 each. £18,370 has been received in respect of 12,566 preference and 5,804 ordinary, and £23,075 is considered as paid on 13,407 preference and 9,668 ordinary. Mortgages and charges: Nil.

Hobart Electric Tramway Co., Ltd. (35,926).—Particulars of £50,000 5 per cent. debentures, created by resolution of December 15th, 1905, and having the benefit of a trust deed dated February 1st, 1906, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. Property charged (by debentures): The company's undertaking and property, present and future, including uncalled capital. (By trust deed): All the company's freehold and leasehold property in Tasmania. Trustees: J. G. Bellamy, Finsbury House, Blomfield Street, E.C.; and A. Matter, 4, Paper Buildings, E.C.

Tramways Extension Syndicate, Ltd. (80,128).—A charge on the sum of 10s. per share payable on 2,000 preference shares, to secure £600, has been registered. Date of charge, February 1st, 1906. Holders: P. Macfadyen & Co., Winchester House, E.C.

British Electric Light Wiring Co., Ltd. (58,013).—This company's annual return, made up to December 14th, was filed on February 2nd, when 156 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £1 per share has been called up on 149, and 10s. per share on 7, and £152 10s. has been received. Mortgages and charges: Nil.

Adelaide Electric Tramways, Ltd. (65,676).—This company's annual return was filed on January 16th, when 7 shares had been taken up and paid for in full out of a nominal capital of £3,000 in £1 shares. Mortgages and charges: Nil.

Tramways Extension Syndicate, Ltd. (80,128).—This company's annual return was filed on January 9th, when 3,000 preference and 140 ordinary shares has been taken up out of a nominal capital of £5,000 in 4,750 preference shares of £1 each and 5,000 ordinary shares of 1s. each. £2,000 has been received. £1,007 remains in arrears. Charge for £600 subsequently registered. Mortgages and charges: Nil.

Lancashire United Tramways, Ltd. (87,044).—A trust deed, dated February 1st, 1906, to secure £300,000 second debenture stock, has been registered. Property charged: Shares and freehold and leasehold hereditaments comprised in a sale agreement dated January 2nd, 1906, and the company's other assets, present and future, including uncalled capital. Trustees: Sir William B. Forwood, Kt., Bromborough Hall, Chester; and R. Watson, Linwood, Renfrewshire.

Mann, Egerton & Co., Ltd., electrical engineers, Norwich (83,780).—Issue, on February 5th, of £300 5 per cent. debentures, part of series created April 1st, 1905, to secure £10,000, charged on certain freehold and leasehold properties in Norwich and Ipswich, and the company's undertaking and property, present and future, including uncalled capital. Trustees: G. F. Buxton, J.P., Dunston Hall, Norfolk; and J. J. D. Paul, J.P., Eaton Grove, Norwich. Previously issued of same series: £9,100.

Durham Collieries Electric Power Co., Ltd. (83,421).—A deed of charge, dated January 25th, 1906, to secure £75,000, has been registered. Property charged: Certain lands in Durham, 14,993 £1 shares in the Houghton-le-Spring and District Electric Lighting Co., Ltd., 1s. paid, £10,000 debentures and 6,000 fully paid £1 preference and 8,000 fully paid £1 ordinary shares in the Sunderland and District Electric Tramways, Ltd., and the company's undertaking and property, present and future, including uncalled capital. Holders: Trustee, Executors and Securities Insurance Corporation, Ltd., Winchester House, Old Broad Street, E.C.

Charing Cross, West-End and City Electricity Supply Corporation, Ltd. (29,122).—Issue, on February 8th, of a £72,000 5 per cent. debenture, part of series created May 31st, 1901, to secure £500,000. Property charged: The undertaking constituted by the "City of London Electric Lighting Order, 1899," confirmed by the "Electric Lighting Order Confirmation (No. 20), 1899," and the moneys and assets then or thereafter belonging to that undertaking, and any present and future investments by the company in the Suppliers' Construction Co., Ltd. No trustees. Holders: Law Life Assurance Society, Ltd., 187, Fleet Street, E.C. Previously issued of same series: £400,000.

ELECTRIC LIGHTING AT TIENTSIN.

The formal opening ceremony of the new power house in connection with the installation of the electric light in the British settlement in Tientsin, was held by the directors of the Tientsin Gas and Electric Light Co. on August 27th, 1905, when the switching-on of the light for the whole of the two concessions was carried out in the presence of a large company.

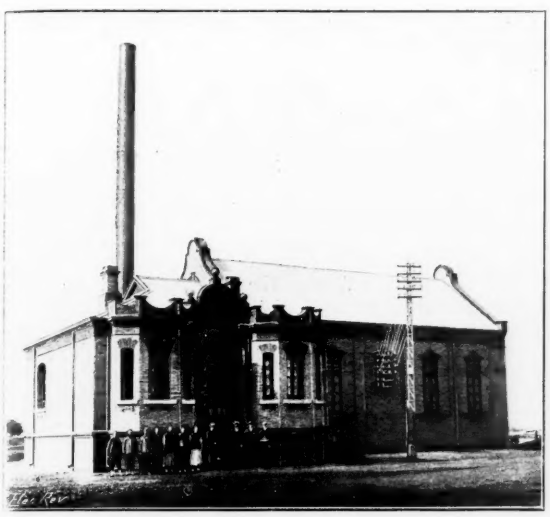

Fig. 1.—The Tientsin Generating Station, showing the Works Staff, also the Overhead Feeders.

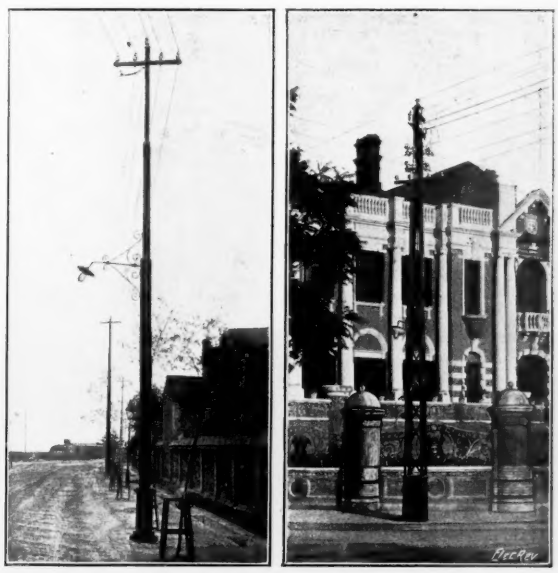

Fig. 2.—Distribution Pole Line, and Lattice Pole Feeding-Point.

Seventeen years ago a system of oil-gas illumination was started by the Tientsin Gas Co., Ltd. It was at that time hailed with satisfaction, as a method of illumination vastly superior to the tallow candle and the kerosine oil lamp.

The company's gas works suffered considerable damage during the Boxer trouble, and shortly after the restoration of peace, when offers for an electric light installation in the town were made to the municipality by other parties, the directors of the company decided in their own interests to lay before the Council a competitive offer with a similar object. This proved a wise step, which incidentally saved the money

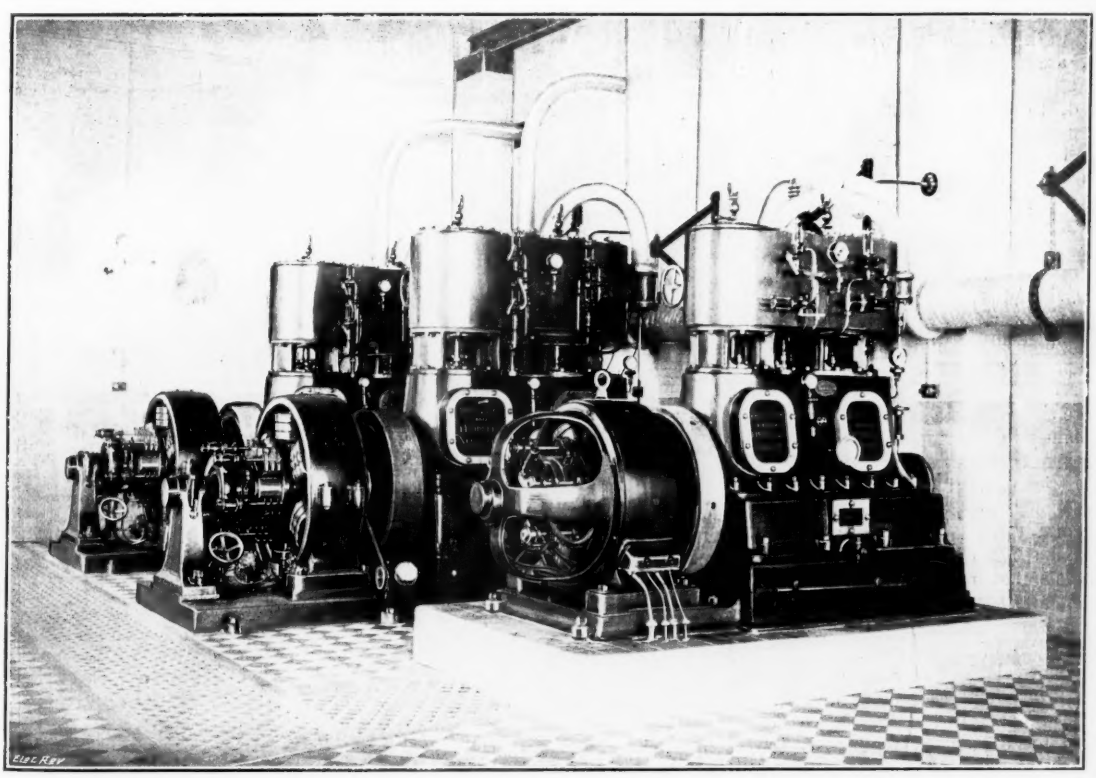

Fig. 3.—View of the Generating Plant.

G

W., law student. No initial public issue. The number of subscribers are to appoint the first; less than three nor more than nine; the subscribers are to appoint the first; qualification, £10; remuneration, £100 per annum divisible. Registered office, 22, Staines Road, Ilford.

Suppliers' Construction Co., Ltd. No trustees. Holders: Law Life Assurance Society, Ltd., 187, Fleet Street, E.C. Previously issued of same series: £400,000.

invested in the gas undertaking; the directors have given the town the option between gas and electricity, and it is interesting to note that electricity is carrying the day.

The whole of the work, including the buildings and the generating and distributing systems, was designed and carried out by Messrs. Arnhold Karberg & Co., of Tientsin, at a cost of £15,000, under the supervision of their consulting engineer, Mr. Geo. van Corbac, to whom we are indebted for the particulars given, and of Mr. A. J. C. Waterland, the chief engineer of the Tientsin Gas and Electric Co.

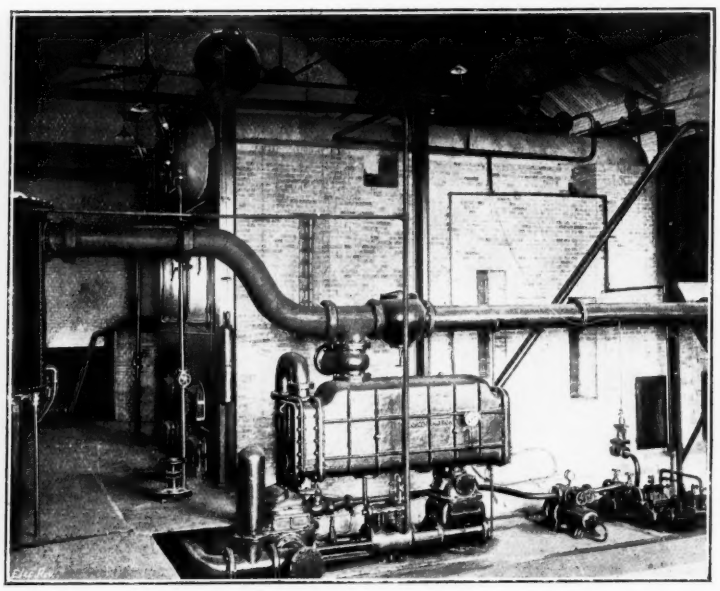

Fig. 4.—Boiler Plant, showing also Condenser, Filter and Feed Pumps.

The works, which we illustrate in fig. 1, are situated close to a canal, where a large plot of land has been acquired, to serve for extensions and other purposes.

The buildings comprise an engine room 60 ft. × 30 ft., a boiler house 60 ft. × 37 ft., together with a suite of offices for the chief engineer and his assistants. The buildings are of brick, and of ornamental design, and space has been provided for additional machinery.

The chimney is of wrought-iron, 4 ft. in diameter and 85 ft. high: it was imported in sections and riveted together on the site. In passing, we may note that it is said to be the highest iron chimney in China.

The generators were constructed by the Electrical Co. (of London), and are direct coupled to high speed enclosed engines of Messrs. Robey & Co.'s make. The small set is capable of developing 40 KW. at 550 r.p.m., and each of the two larger sets, 80 KW. at 400 r.p.m. Each machine is capable of carrying an emergency load of 25 per cent. in excess of the normal load for two hours without injury, and they often do work at this load: as with the Chinese workman, and for economical reasons, it is thought better to load one machine as much as possible, in order to avoid switching in more machines than necessary. Each engine is designed for forced lubrication, oil being supplied to all the wearing surfaces at a pressure of 15 lb. per square inch.

One feature which is occasionally met with in three-wire continuous current stations in this country, and which has been adopted in the Tientsin station, is the provision of static balancers, instead of a balancing motor-generator.

The arrangement is very simple and effective. The balancers are placed in a chamber below the switchboard and require no attention; they are capable of dealing with a 25 per cent. out-of-balance current.

A view of the generating plant is given in fig. 3. The main switchboard seen in fig. 5 is of white marble, mounted on iron supports and enclosed in polished fire proofed wood framing. It contains three dynamo panels and one feeder panel. The former panels are equipped with two ammeters, a three-pole main switch, a B.T.H. wattmeter, and a D.P. main fuse.

The feeder panel has two ammeters and a multiple switch that enables the ammeters to be put on to any one of the five feeders leaving the station.

Above the panels are four illuminated dial voltmeters: one is connected direct to the bus-bars: one by means of a multiple switch to the dynamos, and the other two are connected through multiple switches to the pilot wires, and thus to the various feeding points.

At the back of the board two marble feeder panels are fixed, from which the feeder wires are taken through plug fuses, the whole arrangement being very simple, complete and compact.

The boiler plant consists of two Babcock & Wilcox standard pattern boilers, each capable of evaporating 4,200 lb. of water per hour. The furnace gases pass through a Green economiser, *en route* to the chimney. Each boiler has a heating surface of 1,619 sq. ft., and is provided with all the usual fittings. The working pressure is 160 lb. per sq. inch.

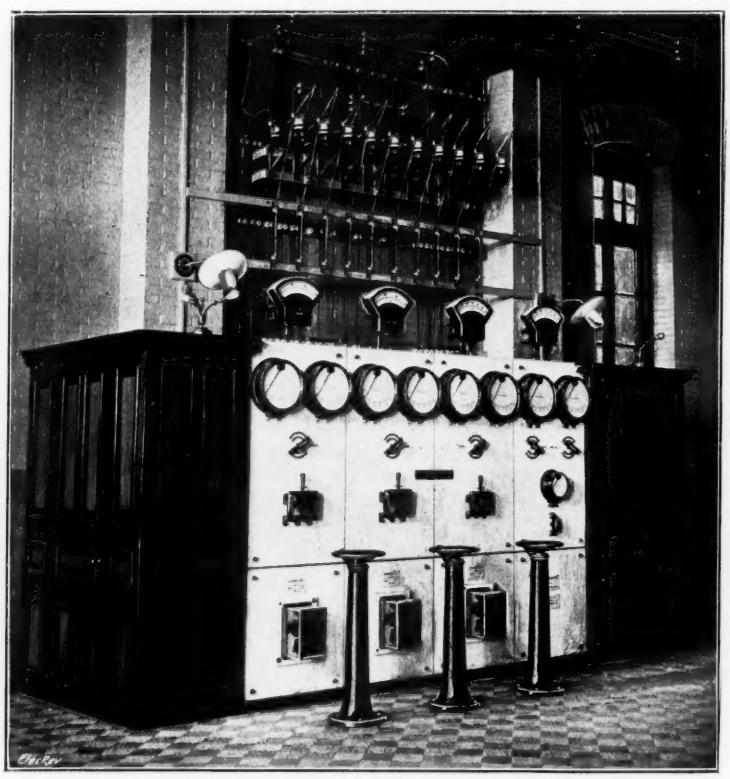

Fig. 5.—The Main Switchboard, showing the Outgoing Feeders, &c.

At the side of the boilers is a Worthington surface con-

denser of 700 sq. ft. area, and two Tangye feed pumps, each capable of pumping 500 gallons of water per hour, against the steam pressure of 160 lb.

The exhaust steam from the engines passes through a Baker oil separator before entering the condenser, and the feed water before entering the boilers is passed through a feed filter. A 1,000-gallon feed tank is provided as a standby.

The steam pipes are lap-welded mild steel, and the exhaust pipes are of cast-iron, and were made locally, by the Tientsin Iron Works.

An interesting feature is the overhead system of mains which has been adopted. The feeders consist of bare conductors ·14 sq. in. and ·075 sq. in. area for the outers, and ·075 sq. in. and ·040 sq. in. for the middle wires.

The distribution network throughout consists of ·040 sq. in. conductors, while for the street lighting, the areas adopted are ·025 sq. in., ·016 sq. in. and ·008 sq. in. The feeder wires are carried on steel lattice poles, and the street lighting and distribution wires on Mannesmann tubular poles.

The streets are lighted by 234 32-c.p. incandescent lamps fitted on ornamental brackets attached to the poles. The practice being to switch the lights on in groups from the five feeding points.

We illustrate in fig. 2 a feeding point, where is shown the arrangement of *circular* bus-bars; each feeder and distributor is fused at these points, so that it is an easy matter to isolate any desired section.

With a suitably designed overhead system, such as that at Tientsin, faults are practically unknown, and the mains superintendent has a very happy time.

Sometimes, however, things occur which are apt to bring the existence of the mains back to the superintendent's mind, as, for instance, when some Chinese bricklayers tied all the conductors together in a bunch to their scaffolding.

Since the works were formally opened, the equivalent of 6,500 8-c.p. lamps has been connected, and the maximum load has reached 88 kw.

The company have a wiring department, which has completed 60 installations and has work in hand for a further 20.

Energy is sold by meter, at 36 dollar cents per B.O.T. unit (about 8d.), and the municipality pay $89·90 per 32-c.p. lamp for street lighting, for an average of 3,650 hours per annum, exclusive of renewals of lamps, cleaning, &c. This is about 4d. per unit.

Coal is fairly cheap and good; Honan anthracite, an excellent steam coal, costs about 26s. per ton d/d, and small coal about 12s.

Chinese labour is, of course, cheap: the works staff consists of a Chinese clerk, who speaks English well, an assistant, who is similarly acquainted with English, one fitter, two drivers, two stokers, four coolies, two lamplighters, a storekeeper and a watchman; and the wages amount to about £15 per month. In addition to the Chinese staff there are two European shift engineers.

During November, 15,834 units were sold to private con-

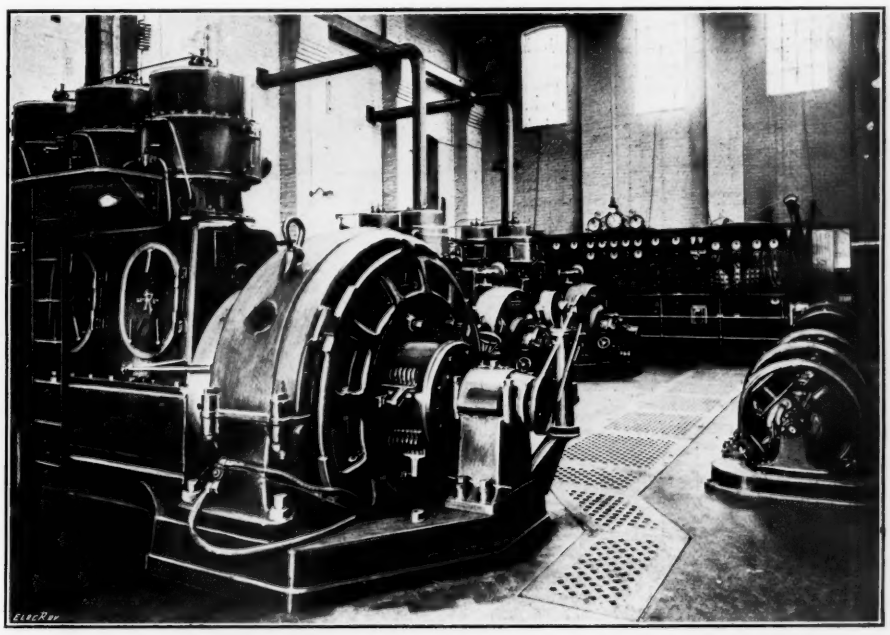

Fig. 1.—Dartford: View of the Generating Plant in the Power Station.

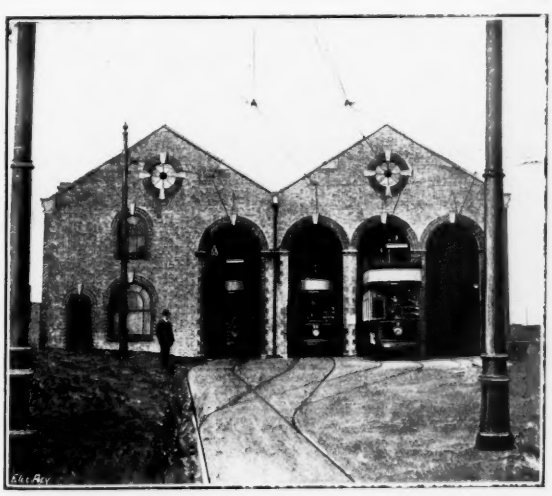

Fig. 2.—Dartford: The Car Depot.

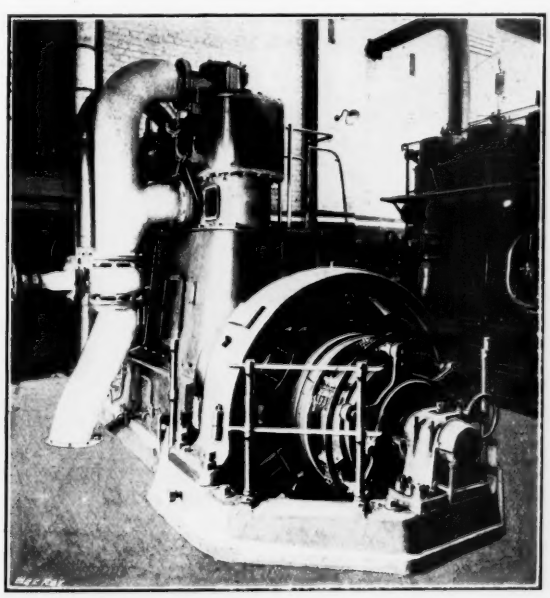

Fig. 3.—Dartford: Browett-Lindley Fowler Generator, Installed in Connection with the Tramways.

sumers and for street lighting, and the revenue obtained therefrom was $4,088; the total works costs were $1,911, thus showing a good surplus. We hope shortly to publish the accounts of this undertaking, which, as it is a typical Chinese electric supply, will no doubt interest engineers in this country.

THE DARTFORD LIGHT RAILWAYS.

Last week we referred briefly to the inauguration of the Dartford Urban District Council's light railway system, which occurred on the 14th inst.

The routes now brought into service form an important link in the various tramway systems which will connect up Gravesend, Dartford, Erith and Bexley with the Woolwich terminus of the L.C.C. tramway network.

The lines constructed form a junction with the existing tramways of the Bexley Council at Crayford, and run through the town of Dartford to Horn's Cross on the opposite side, a point within 1½ miles of the terminus of the Gravesend and Northfleet tramways; there are also two short branches. The "missing link," which can be seen in the plan of routes below, was omitted owing to the opposition of the S.E. & C. Railway Co.

The route mileage is some 6½ miles, mostly single track with turnouts, constructed on the overhead trolley principle, and involving several sharp curves and three gradients of 1 in 12 to 1 in 15½.

The total cost, inclusive of land and street improvements, is approximately £93,000; Messrs. J. G. White and Co., who were the contractors for the whole of the work, with the exception of the power plant and buildings, are also the lessees of the undertaking for 15 years, the Council having the option of terminating the lease at the end of five or 10 years, and Messrs. White defraying interest and sinking fund charges during the term of the lease.

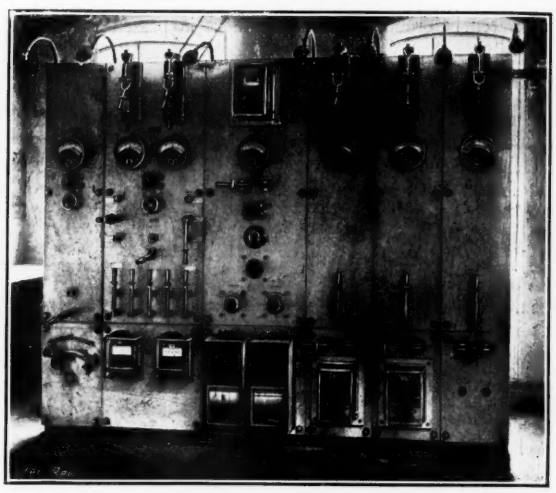

Fig. 4.—The Tramway Switchboard.

Fig. 5.—A Standard Single-truck Car.

throughout the route, are anchored to the concrete underbed.

The anchors used, consist of 12 in. sq. plates, ½ in. thick under the concrete, bolted to the rails with two 1-in. bolts.

The concrete work and paving is of normal character; granite and wood block paving has been used as circumstances required.

The whole of the special work at junctions and crossings is of manganese steel, and was supplied by Messrs. Hadfield.

In the electrical equipment of the track, double concealed bonds of 4/0 B. & S. gauge, are used at the joints, with intermediate bonds at 40-yard intervals. The overhead construction is mostly of the side bracket type, and a double

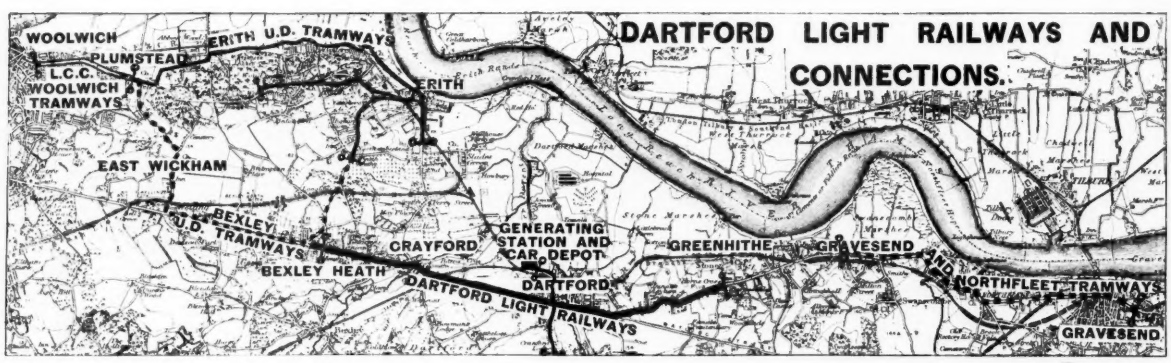

Fig. 6.—Route Plan of the Dartford Light Railways and Adjacent Lines.

The rails are of British standard section, weighing 100 lb. per yard, and jointed together by continuous rail joint plates: all the joints and the rails at 15-ft. intervals

2/0 B. & S. gauge trolley wire is employed throughout with soldered ears. Owing to space restrictions, and the existence of market rights in the centre of the town, the

arrangement of the junctions there, proved a matter of difficulty involving curves of small radius; from this point a short branch leads to the car-shed, passing, *en route*, under a railway bridge, to the girders of which, as no drilling of the structure was permitted, the tramway overhead work was attached entirely by means of clamping.

The car depôt is erected on land adjoining the Council's destructor and electricity works.

It consists of a main brick building 120 ft. long and 48 ft. wide, designed to facilitate extension when required, and capable of housing 16 cars on the four tracks which it contains.

Inspection pits are provided under three tracks, and adjoining are workshops and store buildings.

Kinnear steel rolling doors are provided at the car entrances; the depôt and electricity works extensions were erected by Mr. W. F. Blay, of Dartford.

Twelve double-deck single-truck cars, each with a seating capacity of 56 passengers, have been supplied by the United Electric Car Co., as sub-contractors.

The trucks are of the Brill 21 E type; the electrical equipments, including two 30-H.P. motors, are of Messrs. Dick, Kerr's manufacture.

In addition to the hand-brakes, Westinghouse magnetic track brakes are fitted for use on the down gradients, on which the speed is limited to four miles per hour.

Energy for the operation of the system is supplied from the Council's generating plant, which was originally put down in 1901, with a view to both lighting and traction work. The price per unit varies from 2d. to 1½d., according to the quantity.

For steam raising, four Lancashire boilers are installed, one being provided with a Sugden superheater, and the working pressure being 160 lb. per sq. in.

A Pimbley type economiser, of 192 tubes, is inserted in the main flue, and in connection with the boiler-feeding plant a Lassen & Hjort's water-purifying and filtering plant is installed.

The generating plant comprises two 200-H.P. Reavell two-crank engines with direct-coupled G.E.C. 100-KW. generators; a 400-H.P. three-crank engine by the same builders coupled to a 300-KW. generator by the Lancashire Dynamo and Motor Co., and a recently installed 300-H.P. two-crank Browett-Lindley engine coupled to a 200-KW. Fowler generator. The engines are of the compound, high-speed enclosed types specialised in by the builders, and are run condensing. The condensing plant is of the Ledward evaporative type, with an Edwards air-pump, and is capable of dealing with 10,000 lb. steam per hour.

The water supply is obtained from two wells, with the town supply as an alternative.

The generating plant is supplemented by a 270-cell A.B.P. lighting battery, and by a new traction battery consisting of 250 E.P.S. cells, which has just been installed in conjunction with a reversible motor-booster, supplied by the Lancashire Dynamo and Motor Co.

The original lighting switchboard has been enlarged from time to time, and a new traction board has been supplied by Messrs. Ferranti.

Two positive feeder cables run from the generating station for supplying opposite ends of the route; from one of these a short branch feeder runs.

The above cables are paper-insulated and laid solid in troughing; they supply as usual, through feeder pillars to the overhead line, at ½-mile intervals.

A complete telephone installation has been provided in conjunction with the sectional pillars, giving communication between those points and the car depôt.

One negative feeder is provided, armoured and laid direct. Messrs. Henley were the sub-contfactors for the cable work and feeder pillars.

In concluding this brief description, our thanks are due to Messrs. Hawtayne & Zeden, the consulting engineers, and to Messrs. J. G. White & Co., the principal contractors for the work, for their kind assistance.

Mr. J. D. Pember is the Council's electrical engineer, and Mr. A. D. Murdoch is the tramways engineer and manager.

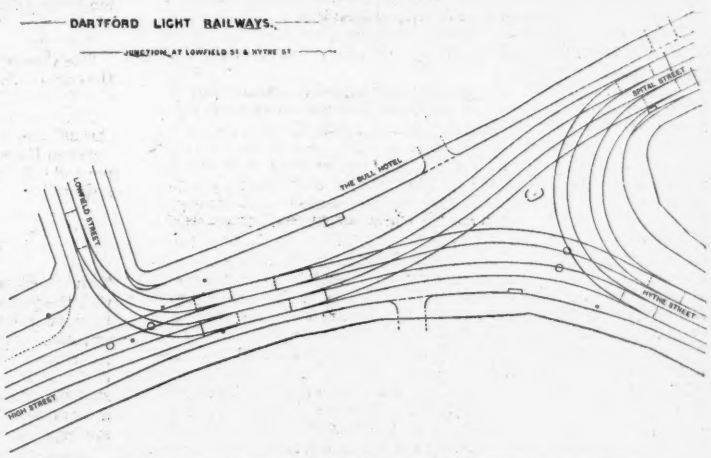

Fig. 7.—Dartford: Special Junction in the Centre of the Town.

Electric Shock.—An accident which took place at Fremantle, West Australia, in November last is worth putting on record, on account of the singular circumstances under which it occurred. J. White, an employé of Messrs. Noyes Bros., constructing engineers to the Fremantle Tramway Board, was painting one of the poles carrying live wires, when it was observed that he had fallen prostrate across the cables, and his flesh and clothes were burning. A messenger hastened to the power station to cut off the current. White appeared to be conscious throughout, but his left hand was burned to a cinder, and his right arm was almost burnt through at the elbow; yet he seemed to be free from pain, and he spoke once or twice on the way to the hospital, where he walked in without assistance. The pressure on the cables was 2,200 volts. In spite of his frightful injuries, the latest report was that he was making progress towards recovery.

Electric Cabs in Berlin.—The introduction of electric cabs in Berlin is being made on a larger scale than that which characterised the experiment made in London a few years ago with cabs having bodies painted yellow. In Berlin, the business is in the hands of the Elektromobile Droschken Actien-Gesellschaft, which expects next month to be in possession of the whole of the 120 vehicles which were ordered originally. According to the company's first report, which covers the period between May and December inclusive, delay took place in the delivery of the charging plant and the cabs, owing to strikes and the great activity prevailing in the trades concerned. As a consequence, the first cabs were received only last September, and a larger number in December, so that the public service rendered by the vehicles was only on a small scale. Nevertheless, the directors state that the working results have shown that the business will be a remunerative one as now carried out by the company on a more extensive basis. The cabs are in constant demand, and the receipts per mile correspond with the calculations upon which the company was founded. The accounts show a slight surplus of income over expenditure, although no provision has been made for depreciation for the short term during which the cabs were in service. It is now proposed to increase the share capital from £75,000 to £150,000 for the purpose of expanding the business. This augmentation has just been sanctioned, and a syndicate has arranged to take over the new shares at the rate of 110 per cent.

Struck off the Register.

It is officially announced that the following companies have been struck off the register and are dissolved:—

Dumont Electric Ignition and Self-Starter Co.
Great Western Electric Light and Power Co.
King Arc Lamp Co.
Lancashire and Yorkshire Electric Tramways.
London Mica Co.
North Cheshire Rubber Co.
Snelgrove Electric Cash Register Till Syndicate.
Taipo Accumulator Co.
United Electric Tramways.
West Riding Tramways and Electricity Supply Co.
Worlds New Accumulator Co.

CITY NOTES.

Electric Light and Traction Co. of Australia, Ltd.

WITH reference to our comments of last week upon this company's refusal to admit us to its annual meeting, we have had a call from the secretary of the company, explaining that it was not the intention that the ELECTRICAL REVIEW should be excluded. Instructions generally were given, we understand, with regard to the Press, in order that the limited accommodation might not be taken up by newspaper men of a certain class, but apparently these orders were exceeded. We are informed that the chairman imparted little additional information beyond that already published in the report.

Metropolitan District Railway Co.

SIR GEORGE GIBB presided at the half-yearly meeting, held at Westminster Palace Hotel on Monday. He said that he fully appreciated the difficulties of the problems they had to face. It would be idle for him to conceal from himself that, during the transition period of the introduction of electric traction, bit by bit, along with steam working, the public had had many legitimate grounds of complaint. Doubtless every effort has been made to introduce the new form of traction with the minimum of inconvenience to the public, and quite recently there had been an undoubted improvement. Not only had the installation of automatic signalling been opened from Earl's Court to the Mansion House, but a substantially increased service of trains had been put on, and the weekly failures, which he knew from experience of electric traction were bound to occur for a considerable time after the trains first began to work, were showing a tendency to become fewer and fewer in number. But he said frankly that he did not think the train service was what it ought to be, and he trusted that, with the assistance of the general manager, Mr. Young, and the other officers of the company, they might shortly improve the train service and get into smoother working.

Mr. R. W. PERKS, M.P., deputy-chairman, said that they had not been able until quite lately to put on an increased service of trains. At the present moment they were running over the most crowded sections, between South Kensington and Mansion House, 24 trains in the hour, against 18 trains in the hour which they were running up to the middle of December. That number of trains they hoped to increase to 30 per hour on that crowded section to 27 on March 1st, and possibly up to 30 in the course of March. That would afford greater accommodation in the rush-hours of the day; but they could not hope—at all events for a long time to come—to arrive at the condition when everybody travelling in their cars would be able to be accommodated with a seat. He need hardly say that at the present moment, owing to the circumstances dealt with in the accounts, the financial results of the application of electrification to the railway were not what they anticipated. The extra cost, undoubtedly, to the railway within this half-year of working partly under steam and partly under electric traction, had been very considerable, and there had been the necessary, but costly, wastage of current caused by the transition from one means of traction to the other, and by the necessity for educating the large number of drivers as to the economical handling of the new motive power. The traffic expenses showed an advance of £13,238. In the train they had seven men in charge, against four men—the driver, stoker and two guards—who used to be in charge of similar steam trains.

Tyneside Tramways and Tramroads Co.

THE annual meeting was held on 12th inst. at Newcastle, Lord Armstrong presiding. The report for the half-year ended December 31st, 1905, stated:—

The surplus of receipts over expenses is £2,337, which, with the balance of last half-year of £266, makes a total to the credit of profit and loss account of £2,602, and after deducting interest on debentures, loans, &c., there remains an available balance of £696 19s. 2d. The gross profit for 1905 shows an increase over that of any preceding year, but the interest payable on mortgages, loans, &c., being greater, the net balance is reduced. The directors propose to deal with this balance by placing £600 to the credit of the reserve account, and carrying forward £96 19s. 2d. The competition of the electrified portion of the North-Eastern Railway has accounted for a considerable diminution in the "long-distance" traffic. The natural increase in other directions has taken some time to counteract this effect, and even now has done little more than balance the reduction. The whole of the track, overhead line, and rolling stock has been kept in thorough repair during the past year out of revenue.

The CHAIRMAN, in moving the report, said that the results had proved rather disappointing, but they had made every effort to curtail expenditure, for increasing the profit as far as was possible, without impairing the maintenance and efficiency of the service. The company had made some progress during the past year. They had not gone backwards as might appear from the fact that for the first time no dividend was payable beyond the interim dividend paid in August last. As a matter of fact, there was an increase in the gross profits for 1905, and this would have appeared greater in comparison than it was but for the fact that in the amounts received during 1904 there was a sum of £554 received from the authorities as rebates in rates paid in previous years, and credited to profit and loss account. They had made progress in every direction. The number of miles run in 1903 was 518,502, in 1904 it was 654,116, and in 1905 it was 666,820. In 1903 they carried 2,641,915 passengers, in 1904 they carried 3,365,277, and in 1905 they carried 3,809,432. The total traffic receipts were in 1903 £16,362, in 1904 £19,728, and in 1905 £20,963. In 1903 the gross profit was £3,104, in 1904 it was £4,842, and in 1905 it was £5,488. The most important factor in their receipts had undoubtedly been the competition of the electrified railway to Tynemouth. The adverse effect of this was practically inappreciable in the first six months of the electrification, but it had become very marked during the early months of 1905. But so far as could be seen from the traffic records they had now experienced the full effects of this competition. During the last three months it had become stationary. With reference to their running powers, the arrangement with the Newcastle-on-Tyne Corporation had been entirely satisfactory to both parties and to the public so far as concerned the routes that were already open. The Newcastle-on-Tyne Corporation had experienced certain engineering difficulties on the riverside route, and, as a consequence, the delay in opening the traffic on that route still continued. This delay involved the company in a material loss. They were debarred from deriving any revenue on this head, and they urged the Corporation to find some way of overcoming their difficulty, for the benefit of the travelling public no less than for the sake of the tramway revenue.

Dr. MERZ seconded the resolution.

Mr. C. D. HILL said that at the last meeting he suggested that they should consider well before they extended their operations. The directors had not taken that advice, and now they came forward with that report, and said it was the long-distance traffic that had affected their profits. He would like to know which was the long route that had affected their receipts like that. He asked where had been the leakage.

The CHAIRMAN said that passengers who used to come from Wallsend and Tynemouth now used the electrified railway. Their standing charges had increased during the past year and this accounted for them having a smaller amount available for dividend.

Capt. JAMES BOLT said he was very much dissatisfied with the financial position and working of the company. He moved that a committee be appointed to look into the working of the Tyneside Tramways, consisting of two of the present directors, three of the most competent shareholders, and one expert in the management of electrical tramways.

The proposition was seconded by a lady.

The CHAIRMAN said he had no objection, but he pointed out that the cost of the Newcastle tramways was 6·9d. per car-mile, and for the Tyneside Tramways it was 5·7d. per car-mile.

Mr. HARRISON (ex-Mayor of Wallsend) pointed to the loss arising through the difficulty with the riverside route.

When Capt. BOLT's proposition was put to the meeting, 11 voted for and 11 against it, and the Chairman gave his casting vote against it.

Chelsea Electricity Supply Co.

THE directors' report for the year ended December 31st, 1905, says that the profit for the year amounts to £36,030, which with £1,170 brought forward and £281 balance of interest, makes a total of £37,481. After deducting interest on debenture stock, £7,875; interim dividend 6 per cent. on preference shares, £900; interim dividend on ordinary shares at the rate of 4½ per cent. per annum, £4,999; amount written off suspense account, £1,891, there remains a balance of £21,816, which the directors recommend shall be appropriated as follows:—

To credit of renewals and depreciation fund	£10,918
To final dividend on preference shares, making 6 per cent. for the year	900
To final dividend on ordinary shares at the rate of 7½ per cent. per annum, making 6 per cent. for the year	8,332
To dividend of 3 per cent. on the 5,000 on ordinary shares exchanged for founders' shares	750
Leaving to be carried forward	916
	£21,816

The 500 founders' shares of £1 each were extinguished by the provisions of the Chelsea Electricity Supply Co.'s Act, 1905, and 5,000 ordinary shares of £5 each were issued in exchange for them in July. 1905. For the year 1905 these new ordinary shares are entitled to dividend at half the rate paid for the year on the old ordinary shares and will from January 1st, 1906, rank *pari passu* with the old ordinary shares.

To the amount of the suspense account brought forward from last year, £4,725, has been added an expenditure of £948, incurred in promoting the Act for the extinction of the founders' shares and in safeguarding the company's interests in respect of the numerous Bills for the supply of electricity which were before Parliament in 1905. The total amount, £5,674, has been written off by placing one-third, £1,891, to the debit of revenue account and the balance, £3,783, to the renewals and depreciation fund. The number of lamps connected on December 31st, 1905, was 221,809, an addition of 11,150 during the year, and the total number of units sold was 3,222,038, being 9,626 more than the previous year.

The smallness of this increase is due partly to a reduction in the demand by some of the large consumers, and partly to a falling off in building operations in the district, which, it is believed, will prove to be only temporary.

Chatham and District Light Railways Co.

THE meeting was held on February 14th, at 83, Cannon Street, E.C., Mr. A. R. Monks presiding. One shareholder only was present.

The directors' report, which was adopted, stated that for the half-year ended December 31st the receipts were £18,505 and the expenses £12,800 = £5,705. After adding the balance brought forward from June 30th, 1905, £2,568, and, deducting interest on debentures £1,000, there remained £7,273. Of this amount £2,000 has been transferred to reserve for depreciation; £387 has been written off; a 5 per cent. dividend is paid on the preference and 3 per cent. on the ordinary shares, and £699 has been carried to the revenue new account. During the half-year the balance of the additional capital (£3,500) h been issued and fully paid up. The

Rochester Corporation are proceeding with the construction of an extension line to Delce Grange, which will be leased to this company.

Half-year ended.	Miles open.	Passengers carried.	Traffic receipts.	Average fare.	Car mileage.	No. of cars.
Dec. 31, 1904 ..	9·33	3,459,119	£15,945 10 0	1·10d.	416,855	35
June 30, 1905 ..	9·33	3,515,595	£16,175 14 6	1·10d.	403,315	40
Dec. 31, 1905 ..	9·33	3,863,298	£17,995 0 1	1·11d.	459,240	40

Notting Hill Electric Lighting Co.

The directors' report to December 31st, 1905, says that the expenditure on capital account during the year has been £4,093, including £2,302 for new mains, and £1,157 for new machinery erected at the Bulmer Place Station. The total capital expenditure has been £228,360. The cost of the joint station to date has amounted to £152,728, and joint debenture stock amounting to £152,500 has been issued. This stock is subject to a cumulative sinking fund, which now amounts to £16,048, invested in trustee securities. The following table shows the progress of the company during three years:—

	Equivalent of 8 c.p. lamps.	Profit.
1903	116,360	£15,018
1904	132,132	£19,890
1905	143,102	£19,984

The number of consumers is now 2,486, and 98 per cent. of these are supplied at 200 volts. The gross revenue for the year was £35,315, showing an increase of £750, and the total net profit was £19,984. From this there have to be deducted the following sums: — Depreciation, renewal and reserve fund, £3,000; debenture interest, £2,560; Kensington and Notting Hill joint debenture stock—interest, £1,872; sinking fund, £993; leaving a balance available for dividend of £11,559. The directors recommend the payment of the usual dividend of 6 per cent. on both the preference and ordinary shares, and that the balance of £3,249 be divided in accordance with the Articles of Association, one-half amounting to £1,624, being credited to the founders' shares and the other half to the ordinary and preference shares. This will enable a further 1½ per cent. to be paid on both ordinary and preference, with a distribution of £3 per share on the founders' shares. An interim dividend of 3 per cent. was paid to the holders of the ordinary shares on July 1st, and the balance of 4½ per cent. will be paid forthwith, together with the distribution on the founders' shares. The preference shares having received their full 6 per cent., the 1½ per cent. bonus will be added to the interim dividend on these shares, to be paid on July 1st next.

Law and Parliamentary costs amounting to £785 1s. were incurred in successfully opposing various new schemes brought before Parliament in connection with the supply of electricity in London, which might have injuriously affected the interests of this company. During the current session several measures will be submitted to Parliament for supplying current in bulk to authorised undertakers, and there is also a Bill promoted by one of the London companies, which as it at present stands would give it powers of competition in every part of London. The directors have received assurances that it is not intended to interfere with this company's interests in any way, but they have adopted a watchful attitude.

At the quinquennial valuation, the value for rating of the company's individual property was raised from £4,598 to £7,656, and that of the Wood Lane works from £3,567 to £5,688. It should be pointed out that the rating of the company's property is based upon its earnings, and is therefore in reality an additional income-tax.

Statement of Electricity Generated, Sold, &c., during the Year ending December 31st, 1905.

Units generated and purchased	2,375,458
Units sold—	
Public lamps	83,884
Private consumers by meter	1,628,071
Total sold	1,711,955
Units used on works	21,320
Total units accounted for	1,733,275
Units expended in distribution, transformers, and accumulators	642,183
Number of public lamps	52
Total maximum supply demanded	1,370 kw.

South Metropolitan Electric Light and Power Co.

The report of the directors for the year ended December 31st, 1905, says that the revenue account shows a credit balance of £22,131, which, with £6,707, the balance brought forward from the previous year, makes a total of £28,838. After deducting £7,965 for interest on debenture stock paid and accrued, and for other interest, and £2,988 for interim dividend paid on 7 per cent. cumulative preference shares, there remains a balance of £17,885, which the directors recommend should be dealt with as follows:—Final dividend upon the 7 per cent. cum. pref. shares, £3,460; depreciation account, £4,000; dividend to December 31st, 1905, upon the ordinary shares at the rate of 2½ per cent. per annum, £2,677; and that the balance of £7,748 be carried forward. The business of the company continues to make steady progress, as will be seen by the following comparative figures:—

Year.	8-c.p. lamps connected.	Increase.	No. of consumers.	Gross revenue.	Expenditure.	Net revenue.
1903	60,540	15,624	1,734	£19,450	£8,409	£11,041
1904*	108,891	47,851	2,555	£28,797	£12,222	£16,575
1905	125,674	17,283	2,858	£35,422	£13,290	£22,131

* Including Crystal Palace Co.'s area from June 16th, 1904.

The expenditure of the Crystal Palace and District Electric Supply Co., Ltd., has been brought into the capital account at the figures certified by the official auditor to the Board of Trade, at the date of transfer. The difference between the amount of the certified accounts and the price paid by this company has been applied in writing down the following items in capital account No. 3:—Expenditure of the Crystal Palace Co., machinery and plant, £13,116; cost of provisional orders, &c., £17,806; and in writing off the account in the general balance-sheet, obtaining release of debenture stock-holders' rights, £22,158. During the year a further £51,708 4½ per cent. debenture stock, 32,600 preference shares, and 16,300 ordinary shares of £1 each were offered to the proprietors, and largely over-subscribed. The net premiums arising from this issue amount to £5,245. The directors have applied £1,745 of this amount in reduction of preliminary expenses account, and have carried the balance of £3,500 to reserve account. In order to deal with the rapidly-increasing demand for power, and to afford a supply of energy in bulk, authorised by the company's Act of 1903, the directors are erecting a further engine and boiler house on the most economical and up-to-date lines. The directors are applying for power in the ensuing session of Parliament to make agreements for combination with other companies, and for the supply of energy in bulk to, and for taking energy from, one another.

Cambridge Electric Supply Co.

The directors' report states that during the year 1905 there have been connected, the equivalent of 3,224 8-c.p. lamps, making a total to date of 50,336.

The number of units supplied during the year has been 559,640, an increase of more than 96,000 units. During the year two new steam dynamos have been delivered, in addition to a fifth boiler and a new feed-pump. At the same time one of the original steam dynamos, which had become too small for its work, has been disposed of. An extension has been made to the boiler house which greatly facilitates the handling of the coal. £5,000 has been received by the company, being the balance of the debenture issue, which is now fully paid up. During the year the rating assessment on the company's undertaking has been very greatly increased, and the directors are taking all the necessary steps to obtain a reduction. After placing the sum of £1,744 to depreciation fund account, which will bring up the amount standing to the credit of that account to £4,000, the accounts of the company show a balance of £5,991, which added to £1,764 brought forward from 1904, makes £7,755. An interim dividend of 2½ per cent., absorbing £2,120, has already been paid, and after deducting debenture and other interest £1,332, there remains a net balance of £4,303 available for dividend. Out of this the directors recommend the payment of a further dividend of 3½ per cent., making 6 per cent. for the year. This will absorb £2,968, leaving a balance to carry forward, subject to adjustment of income-tax, of about £1,334.

Westminster Electric Supply Corporation.

The directors' report for the year 1905 states that the supply of current, which, on December 31st, 1904, was provided for the equivalent of 711,679 lamps of 8 c.p., had increased by December 31st, 1905, to the equivalent of 764,930 lamps, and applications for supply continue to come in at a satisfactory rate.

The length of roadway in which continuous current mains have been laid now exceeds 77 miles, making about 293 miles of ducts, into which upwards of 241 miles of copper (strip and cable) have been drawn. In addition, three miles of trunk mains (12 miles of ways) are laid in the company's area to connect the stations with the Central Electric Supply Co.'s station at St. John's Wood. The system of public lighting undertaken by this Corporation continues to give great satisfaction. The station of the Central Electric Supply Co. at St. John's Wood has been working well during the year, and has supplied a large amount of current to this company. The new transformer station at Duke Street Gardens is now completed and at work. By the Thames Embankment Improvement scheme, the London County Council have obtained powers to acquire the Corporation's generating station in Millbank Street, but have to reinstate the station on a new site. This matter has been referred to arbitration, which is now proceeding. The whole of the recent issue of 50,000 preference shares was taken up by the shareholders at a premium of 7s. 6d. per share, and this premium has been taken into reserve fund, out of which the cost of conversion of the 5 per cent. preference shares, and expenses of the issue of the new 4½ per cent. preference shares will be paid.

The reduction in price which came into force on January 1st, 1905, has, as was anticipated, resulted in the sale of an increased number of units, although for the present there has been a decrease in the year's revenue. The charge for current used for power, heating and cooking, has been further reduced to 1d. a unit from January 1st, 1906. The continued increase in the rates and heavy Parliamentary expenses have also contributed to the decrease in the balance available for dividend. The recent quinquennial valuation, even after successful appeal, has resulted in an addition to the rateable value of the company's undertaking of no less than £20,000, which, on present figures, equals a yearly increase on rates of £7,000, or over 60 per cent. This must hamper the board in their desire to make a further reduction in the charge for electricity.

In the last Session of Parliament, the company had to oppose the Bill of a new company, and heavy expenses amounting to £4,200 were necessarily incurred in defending the company's interests. A similar Bill has been again deposited for the ensuing session—as have also Bills by other companies, and by the London County Council. The powers and privileges they ask are considerably in excess of those which have been granted to company's supplying electricity in London hitherto, and if confirmed by Parliament, would give them great advantages in competition with existing companies working under provisional orders. The directors consider that if further powers are granted they should be given to the existing companies, and that the proper way to deal with the question of the supply of electricity in London is to allow a grouping of adjacent companies for mutual assistance in providing a bulk supply.

In these circumstances, although the balance available is sufficient to pay a dividend at the same rate as last year, the directors consider it advisable to carry forward a larger amount than usual, and to pay a dividend of 13 per cent. for the year instead of 14 per cent. as for the year 1904. An interim dividend, at the rate of 13 per cent. per annum on the ordinary shares and the dividend on the 5 per cent. preference shares, for the half-year ending June 30th, 1905, has been distributed. After allowing for depreciation, sinking fund and other charges, the net balance is £45,966 10s. 9d., from which must be deducted the second half-year's dividend on the preference shares, which absorbed £3,342 19s. 2d., leaving a balance of £42,623 11s. 7d. Out of this the board recommend the payment of a dividend at the rate of 13 per cent. per annum, less

income-tax, for the past half-year, carrying forward a balance of £8,661.

Statement of Electricity Sold, &c., for Year ending December 31st, 1905.

Quantity utilised:—	
Sold to consumers	14,899,170
Used on works for lighting, meter testing, &c. ..	178,692
Total	15,077,862
No. of lamps on circuit, December 31st, 1904	764,930

Alex. B. W. Kennedy, *Engineer-in-Chief.*

Yorkshire Electric Power Co.

In their report to be submitted to the half-yearly meeting to be held at Leeds, on February 27th, the directors express their conviction that it has been shown during the past half-year that there is a large and increasing demand from manufacturers and consumers in many different branches of industry for the electrical energy which the company has to dispose of, and the experience of this period has demonstrated conclusively that the purposes for which the company has been formed are fully justified.

Inquiries are being received almost daily from would-be consumers in many parts of the area, and it is evident that the company must play a considerable part in the development of the trade of Yorkshire. It has already been reported that agreements have been entered into with several local authorities for the supply to them of electricity in bulk, and further agreements are being discussed with other local authorities, a number of which will, it is confidently expected, be completed at an early date. Authorities holding provisional orders, who are themselves undertaking the distribution of electricity, have seen the advantage of the company's supply in their districts. The Corporation of Pudsey, and the Urban District Councils of Mirfield, Liversedge, and Ravensthorpe, have already consented to the company supplying power users in their areas, and negotiations are proceeding with several other local authorities to this end. Agreements have been made with colliery proprietors, textile manufacturers, and other power users requiring approximately 1,600 H.P.; in addition to these, inquiries are being dealt with which will, when concluded, require more than double this horse-power, and the directors have every expectation that in many cases definite agreements will be concluded at an early date. It is a matter of satisfaction to the directors that several consumers, already connected, have decided, from their experience of the company's supply, to increase their original installations.

The generating station at Thornhill is now in thorough working order. All the machinery is running satisfactorily, and the third turbo-generator, which has passed its test at the works of the makers, is now being erected. The tests of these machines have shown that although ordered as being of 1,500 KW. capacity, the rating may be safely increased to 2,000 KW., and when the contracts entered into are complete, machinery will have been installed at Thornhill capable of producing 6,000 KW., or slightly over 8,000 H.P. The load on the generating station is increasing, whilst the unit cost of producing the power is diminishing in a most satisfactory manner. The directors are satisfied that the plant and system, generally, which have been adopted, are of the most up-to-date type, and it is their opinion that they are in a position to produce energy on as favourable terms as any other undertaking in Great Britain. Energy is being supplied in Thornhill, Mirfield, Gomersal, Pudsey, Ravensthorpe, Hartshead, Chickenley, Kirkheaton, Soothill Nether and Drighlington.

Important inquiries have been received from colliery proprietors in districts in the company's area which are somewhat distant to be supplied conveniently from the Thornhill station, and negotiations are at present in progress for the development of the company's business in these areas by means of subsidiary generating stations. Several inquiries of considerable importance have also been received from the various railway and navigation companies within the area, and there can be little doubt that a large business should be procured in the near future.

The directors have every hope that the coming year will see a large increase in the amount of energy distributed from the generating station. Underground cables to the extent of 65 miles have been laid and brought into use to the end of 1905, and further extensions of mains have been ordered. The constructional work in connection with the company's first station having been completed and the business of supply to consumers entered into, the directors have decided that for the present, during the early period of development, they will forgo £600 out of the £1,100 per annum voted to them by the shareholders for their services and travelling expenses. At the meeting of the shareholders held at Ravensthorpe on September 26th last, resolutions were passed to sanction the borrowing by the company of a sum not exceeding £80,000, by mortgage or by the issue of debenture stock. No money has yet been raised under this authority, but an issue of debenture stock is contemplated at an early date.

Imperial Tramways Co.

The directors' report to December 31st, 1905, gives the following particulars relating to the subsidiary undertakings:—

Middlesbrough, Stockton and Thornaby Electric Tramways.—Gross receipts, £51,387; passengers carried, 9,935,876; compared with £51,097 and 9,818,349 in the preceding year. The net profit for the year, £16,825, also shows an increase. The work of constructing the extensions at Middlesbrough, recently authorised, has not yet been proceeded with, as up to the present satisfactory arrangements have not been concluded for dealing with the interests of the toll-gate owners and other important bodies.

London United Tramways (1901), Ltd.—The company's holding in this undertaking remains at 44,446 fully-paid 5 per cent. preference £10 shares, and the dividends received in respect thereof for the past year amount to £21,112.

General.—The company's net revenue account for the year shows an available balance of £41,648, and, after payment of interest on the debenture stock for the whole year, and interim dividends on the preference and ordinary shares in respect of the half-year to June 30th last, amounting together to £26,125, it is proposed to appropriate the balance as follows:—Dividend at 6 per cent. per annum on the preference capital (paid on January 1st last), £5,700; final dividend at 10 per cent. per annum (making 9 per cent. for the year) on the ordinary capital (less income-tax), £9,500; and to carry forward to the next account £323. The reserve funds now amount to £122,872.

Bournemouth and Poole Electricity Supply Co.—The directors recommend a dividend of 7 per cent. on the ordinary shares for the year.

Great Northern, Piccadilly and Brompton Railway Co.

Sir H. Fowler, M.P., presided on Wednesday, February 14th, at Hamilton House, over the half-yearly general meeting of the above company.

In moving the adoption of the report, the Chairman said the capital expenditure for the half-year had been £578,000, and the estimate for the current half-year was £700,000. From the engineer's report, it would be seen that the progress made during the half-year had been very satisfactory. He had hoped that at that meeting, which was the last occasion on which he would have the honour of addressing them from the chair, he would have been in a position to state when the line would be completed. However, they were told not to prophesy unless they knew, and at the present time he would make a mistake if he attempted to state any specific time. All he could say was that the board of directors were satisfied with the progress of the works, and believed that the engineers were doing their utmost to complete them at the earliest possible moment. He hoped that at the next half-yearly meeting his successor in the chair would be able to indicate the possible time when the line would be opened for traffic.

Lord Geo. Hamilton seconded the motion, and it was agreed to.

A dividend at the rate of 4 per cent. per annum was declared to be payable out of the rent due from the Underground Electric Railways Co. under the terms of the agreement for the lease.

The meeting was then made special, and on the motion of the Chairman resolutions were passed—

Sanctioning the creation, issue and disposal, by the company of the ordinary share capital of £390,000, authorised by Section 55 of the Great Northern, Piccadilly and Brompton Railway (Various Powers) Act, 1905; and sanctioning the exercise by the directors of the company of the borrowing powers conferred by the Brompton and Piccadilly Circus Railway Act, 1902, the Great Northern, Piccadilly and Brompton Railway (Various Powers) Act, 1903, and the Great Northern, Piccadilly and Brompton Railway (Various Powers) Act, 1905, in so far as the same have not already been exercised by the creation of 4 per cent. perpetual debenture stock, or otherwise, and empowering the directors of the company to issue such debenture stock from time to time in accordance with the provisions of the said Acts.

Lord Geo. Hamilton said that as that was the last occasion on which Sir Henry Fowler would be with them, he would move a hearty vote of thanks to him on behalf of the board and the shareholders for his past management. Mr. Probyn seconded the motion, and it was carried.

Smithfield Markets Electric Supply Co.

The directors' report for the year 1905 says that the gross profit amounted to £6,770, compared with £6,269 last year, an increase of £501. The net profit for the year was £3,650, to which must be added the balance brought into the accounts from last year, £1,660, making a total of £5,320. Out of this sum £1,500 has been placed to general reserve fund, bringing the total at the credit of this account to £7,460, and the directors now propose to deal with the balance of £3,820 as follows:—By the payment of a dividend at the rate of 4 per cent. for the year, £2,400; and to carry forward £1,420. A satisfactory reduction has taken place in the costs of production, due to greater efficiency in working and to the larger output. The opening, in the early part of the year, of the cold store above the generating station, to which this company supplies current, has at the same time adversely affected the net revenue, the rental hitherto derived therefrom having been partially absorbed by the cost of supply. The directors have decided after careful investigation to install a system of mechanical stokers as a means of dealing effectually with the smoke trouble, which will, they confidently expect, result in a saving in working expenses. The plant and machinery have been fully maintained out of revenue, and are in good condition.

On Friday the meeting of the company was held at Winchester House, E.C., Mr. H. S. Leon in the chair.

The Chairman, in moving the adoption of the report, said that during last year there had been an increase of £200 in the capital expenditure, which was represented by new motors and installations. The gross increase in the revenue over the previous year amounted to £363. The gross profit was £500 more, but the net profit was £650 less. That decrease in the net profit was accounted for by the fact that they had supplied the cold storage with current in 1905, upon which there was only a profit of £317, whereas in 1904 there was practically no current supplied to the cold storage, and they obtained £1,500 profit under the old agreement. That meant a loss of nearly £1,150. Legal expenses were rather a heavy item, and these arose from the negotiations with the Corporation in respect to their lease, and also in connection with an appeal which they had made on their assessment. The appeal resulted in a considerable reduction from the first valuation, but he was afraid their rates and taxes might be £300 or £400 more a year for the next four or five years. They had had some difficulty with the smoke trouble. There was always a great deal of trouble with manufacturers who came under the jurisdiction of the L.C.C. or the Corporation in regard to smoke. They had had to tackle the question and had thought it advisable to install some automatic stokers which were supposed greatly to remedy the smoke nuisance, and in addition they would considerably reduce the working expenses. The cost of producing the current during the year had been reduced by about ¼d. per unit. That was not profit to the company because a similar reduction had been made to consumers. Consumers were still economising, and the tendency in the future was to lower the price, and it was absolutely necessary if they were to compete successfully with gas to consider the question seriously. They had lost some customers during the year, and they had gained others, and the units sold showed an increase of about 9 per cent. That increase would be larger in 1906, but as the price would be lower he was afraid that their net revenue would not increase. He was sorry to say that they could only pay the same dividend as last year, and not, as he hoped, an increased one. They were face to face with great competition; their rates would be higher, and he attached great importance to that part of the auditors' report in which they gave it as their opinion that it should be decided at once as to the policy which should be adopted regarding the application of their revenue in view of the contract which they had to light the Central Markets,

which would expire in 1913. That forced the board carefully to consider at once the position of the company—not so much its present financial position, which was perfectly sound, but the position it would be in in 1913 when the contract with the Corporation expired. It would be for the board to consider what provision was to be made to meet that event. It required a great deal of consideration and thought, and directly the board had come to any final decis on on the matter the shareholders would be frankly dealt with and the whole circumstances placed before them.

Mr. E. Schenk seconded the report, and it was adopted.

Charing Cross, West End and City Electricity Supply Co.

Mr. W. F. Fladgate presided at this company's meeting held at 66, St. Martin's Lane, W.C., on Monday, and in moving the adoption of the report, he first corrected a printers' error in the mains mileage of the City undertaking, which is 268 and not 286 as stated. Before commenting upon the accounts, he wished to refer to two paragraphs of the report on the City undertaking which dealt with the balance of its revenue account. He was afraid that the impression made upon many of the shareholders and the public by the statement in the report, was that the City undertaking had during the year been deficient in earning the dividend on its preference shares by a large sum of money, and he must admit that, except to the accountants, that was an error which might be easily pardoned. It did look like it, and as the board were responsible for it, it was for the board to say that they ought to have worded it more clearly. As a matter of fact, the earnings of the City undertaking this year had been sufficient to pay the whole of the dividend on the City preference shares with the exception of £2,272. The net revenue was £43,743, which was sufficient to pay £20,000, the interest on the debentures; £8,015, the interest on temporary loans; and leave a balance of about £15,700 applicable to the payment of £18,000, the dividend on the preference shares; therefore the deficiency was only £2,272. He wanted to state that at once, because it appeared from letters they had received that the report was not as clear as it ought to be. Owing generally to the state of the company, and to the work which they had been doing, it was naturally with feelings of regret that they had felt bound to give only a 5 per cent. dividend; but speaking from that chair, he had on more than one occasion stated that he feared that the result of undertaking the work in the City would sooner or later be that they would be obliged to reduce the dividend, and all that they could do was to do their very utmost to keep it up as long as it was possible. Notwithstanding the drop in dividend, he still told them perfectly frankly that he did not regret for one moment their having taken powers to supply the City of London. He felt confident that had they not done so—had they not increased their area of supply—they would have found themselves in a by no means satisfactory position, so that he in no way regretted the course which his board, with his full and entire concurrence, took when, some years ago, they obtained that order. The reason of the drop in the dividend was really obvious. It was absolutely impossible in dealing with a large area like the City to gauge to a nicety the exact amount of expenditure which would be equivalent to the exact amount of work that could be done and of profit that could be earned. Had they been able to do that they could, of course, always have made the two ends meet exactly; but such a course would have been absolutely impossible—at any rate, for human boards. They could not say exactly how many lamps they might supply; they could not say how much they might be asked to give in power, and all they could do was to act according to the advice of their engineer and make provision for what they might consider certain to come, and also for that which might come in, and he could not say that he was personally very disappointed—indeed, he did not admit any disappointment with what they had done. They had done exceedingly well. There was one other matter they had in consideration when they designed the Bow station and put down the mains, and that was that in their Act, which enabled them to carry their mains from Bow to the city, they took powers to supply—if they would take their energy—certain of the local authorities. They thought at that time it was not at all unlikely that they would come to this company for a large amount of power. They had not done so. They could not help that. They could not force them to take it, but had they done so the company would have been making a profit on money which was at present unproductive. In the opinion of their engineer, the money which was practically unproductive was no less a sum than about £350,000 to to £370,000. The buildings, machinery, and mains were there, and they were in a position to at once give them supply. To illustrate the necessity for having put themselves into this position, he might instance that two years ago for practical purposes they had come to terms with one of the railway companies who were electrifying their system, to supply energy; they accepted the price quoted, and both sides were satisfied on that point, but a difficulty arose as to whether they could legally give supply. They had not the legal powers to supply a railway company, as in effect they would be supplying current outside their area. The matter, therefore, fell through, but not for want of power on the engineer's part. The Bill which they were now promoting, was for the express purpose of obtaining the powers needed for such a case. Another reason for the drop in dividend was that although business had been moving, and they had been making progress, gas competition and competition all round, and the fact that the public were beginning to understand electric lighting and to use less of it, had had a downward tendency as to the prices they could obtain, and consequently to the profit they could get. People formerly were quite ready to pay a considerably larger price for electricity, but the effect of the schemes which were very much in the air last session, and in the preceding session—the schemes which told you that electricity cost something less than nothing—made people believe that they ought to get their current very cheaply, and consequently the company had not got the prices they had hoped to get. Further, he was informed by the secretary that in many cases customers were hanging back because they thought that under the new power schemes they would get their current at a cheaper rate hereafter. These were reasons, if they came to consider them, which were really patent to everyone for the purpose of showing why the drop in the dividend had occurred. The effect remained, and if it was not that he had quiet confidence in the future of the company, he would not deal with the present report and accounts in as cheerful a way as he could deal with them. It might be interesting to them in taking this question of how matters had been going, not that he should prophesy as to what was going to happen—he had tried that once very successfully in that room, but he would not try it again—but to show what had happened. The figures of revenue from sale of current for the last five years showed that there had been continuous progress. The West End undertaking in 1901 had a revenue of £102,700; in 1902 of £119,000; in 1903 there was a drop to £113,000; in 1904 they recovered to £125,500; and in 1905 it came up to £130,733, and that was a very wholesome increase. The City undertaking figures were even more encouraging. In 1901 they were £9,854, and there was a loss of £776; in 1902 £28,537, with a profit of £4,600; in 1903 £57,700, with a profit of £21,000; in 1904 £80,668, with a profit of £33,000; in 1905 £95,340, with a profit of £41,000. Those figures spoke for themselves, and showed a regular and healthy increase, and as far as the City was concerned, if they omitted the second year of that undertaking, they really were satisfactory, as showing that they really were earning a considerable profit on the money expended in the City. The fact was the works were finished and taken over at a quicker rate than they had brought income, and generally, because of what they had idle, there they were some years in advance of their requirements. As the increase in demand utilised their plant, there should be a dividend on the whole of the capital of the City undertaking. They intended to do all they could to study such economies as might be possible, at the same time being careful to fulfil, as they always had—and more than fulfilled—the statutory obligations put upon them in supplying current. Capital expenditure could not stop, and never would stop, because there was always the normal increase which required certain capital expenditure, but they did not look during the current year to have any large amount. They had in contemplation in the West End a sum of only about £30,000, and in the City not more than some £12,000, and that amount would, they thought, be sufficient for extraordinary purposes. The normal expenditure they could not make any accurate estimate of, because it must go on as the business increased, and they would be very sorry if the normal expenditure ever ceased. Turning to the various items in the report, the chairman said that they had added 43,622 lamps in the West End, bringing up the total to 453,285; of these, 103,655 represented motors. The increase was satisfactory, and there were areas which were not by any means fully occupied by buildings. The new streets between Aldwych and Kingsway had as yet been hardly touched, and they hoped that these would be a fruitful source of profit in the future. In the accounts there was no alteration in the share capital since last year. The loan capital account had increased by £66,000. He wished to call their attention to certain items in the capital account. There were credit items amounting to £36,410 which had been written off the depreciation account. That had been a somewhat drastic writing off, but the directors thought that it was wise to make the arrangement. The Maiden Lane Station was their old original steam station, and for some years it had been going out of use, and they determined to bring it absolutely up to date and to make it a motor generating station, with the result that they had, he thought, more than doubled its capacity, but of course they were bound to write off the sum in their books, which represented what was no longer being made use of. The result was that £36,410 was written off the depreciation account No. 6 of the West End undertaking. There had been an expenditure of £21,000 on mains, and that had been principally employed in the ordinary normal increase of business of the company, and particularly in laying down mains in connection with Aldwych and Kingsway. Passing to the revenue account, coal on the whole undertaking—which was probably the best way of testing the cost—was 11d. down. That was almost the same decrease as last year, and it was satisfactory; the actual money-saving on the West End was, in round figures, £2,000. They had carried £11,000 to depreciation and £48,647 to net revenue. On the credit side of the revenue account, the sales of current had increased by £4,900. That was not as much as they would have liked it to be, but the reasons for it not being more he had already explained, and the fact that there was a considerable increase was, at any rate, satisfactory. There was an item of £1,905 interest on debentures of the Charing Cross and City Electric Co.; that was the construction company, the name of which they thought it wise to change last year. There was £3,550 the balance of interest on loans used in the City undertaking. The share premium account of £3,666 represented the costs in relation to the promotion of their Bill this session and the opposition to the other Bills. This account was in the nature of a capital account. They were not allowed to use it for purposes of income, but under the advice of their auditors they had thought it was a fair account against which they might write the necessary expenses of opposing the Bills of last year and promoting their own Bill. The balance-sheet was comparatively a simple one. There was £985,000 capital ex-

penditure on the West End undertakings alone and £350,000 which, in fact, was the holding of this company, through the Construction Co., in the ordinary share capital of the City undertaking, a most important item, because it gave the benefit of the whole of the unearned increment in the City undertaking to the shareholders of the West End undertaking, and was an asset which, to his mind, was of the very greatest importance. The other item was money used for the purposes of the City under their provisional order; on that interest was paid. The reserves were still £194,000, which they thought quite sufficient, and a very healthy amount. Passing to the City undertaking, there was no alteration in the share capital account. The loan capital account stood at £400,000 of debenture bonds, which matured in the course of this year, and the dealing with those bonds was under the consideration of the directors, who would shortly prepare the necessary arrangements for paying them off, and they had every hope that they would raise their money at some slightly decreased rate, instead of 5 per cent. On the capital account of the City undertaking during the year there had been a total expenditure of about £74,000, the bulk of which had been spent in completing the Bow station, which was being gradually brought up to a capacity of 800,000 lamps, which gave a very large margin. The revenue account of the City Co. was exceedingly satisfactory, the receipts having increased by no less than £13,700, being £92,210 as against £78,431 last year. In coal there was a saving of £2,384. There were increases on wages and repairs, which must necessarily come as the business was being fostered and grew. The net balance was sufficient to meet the whole of the dividends on the preference shares with the exception of £2,700 as already stated. This, then, was the statement of the company as it stood. They would probably say that at present they had made no provision for depreciation of the City undertaking. That was perfectly true—they had not made it, for two reasons. First, in their opinion, the plant was absolutely brought up to date; and, secondly, depreciation had got to be considered with particular regard to the possibility of the business being taken over by the local authority either at the end of the term or in 1913 for the City undertaking. If it were taken over in 1913 under their provisional order, what they were entitled to receive was not the breaking-up price as under other provisional orders, but was the expenditure made upon the City undertaking plus 10 per cent., and plus 4 per cent. per annum if they had not earned 4 per cent. during the intervening years. Having regard to those facts, they did not see that they need make any provision for depreciation in the City. For the current year the business was proceeding, and, personally, he had every hope that the result of it in the City would be that they would pay, on their own account, the whole of the preference dividend for the year 1906. The guarantee which was given by the West End undertaking ran out in June, 1906, and he did not feel nervous as to that fact. The chairman then made reference to the subject of bulk supply. At the present moment there were three large undertakings applying for bulk supply powers in London—the L.C.C., Mr. Merz's company, and the St. Neots Bill. There was also the Bill promoted by this and other companies. They had petitioned against the three big schemes in order to get a voice at the deliberations. In regard to their own Bill, they had cut it down practically to dimensions according with the suggestions of the Board of Trade. The Bill now practically only provided for interchange or sale, or purchase of current, between the London companies, and for the supply outside of their provisional area of railways, canals and dock companies. These were very modest suggestions, but in their opinion they would be of considerable use. Speaking for himself, and not necessarily for his board, the chairman said that the proper way to deal with this question of bulk supply was by Royal Commission, which would consider the interests of all parties. They were told by Mr. Merz in committee room last year that the power consumer's name was legion; they were sceptical to whether he was so great as stated. Among the reasons given for Yarrow's works leaving London, the question of cheap supply of electricity was not one. There were many reasons why carrying on a large business was becoming monthly and yearly a more difficult problem in London, and he did not believe that the question of cheap electricity was one that actuated the men who were carrying on these big businesses, and were moving them away. Again, speaking for himself, he thought that the best way to deal with the matter would be a scheme which, in common with one or two other London companies, he endeavoured to put forward last year in the autumn—the formation of a new company practically promoted and fostered by the great electric lighting companies of London. It appeared to him that the interests of all parties, including the public, would thus be better regarded than in any other way. The consumer could thus get his power at once. This company was in a position to supply a large amount of electricity at bulk rates. If they had the accommodation of the other electric lighting companies they would be able to deal with the consumer. The whole of the network of mains of the existing companies could be used, and there would be a saving in main-laying and street-opening. There would be no question of the immediate construction of stations. There were many stations in London like their own capable of giving supply. All this might be little more than a dream of his, but if a Royal Commission could be appointed the advantages of such a scheme could be brought before it. The Chairman concluded with a word of appreciation of the services of Mr. Seale, the secretary, and Mr. W. H. Patchell, their engineer, who had been again honoured by the Home Office calling upon him to assist them in certain matters.

Mr. John Gatti seconded the adoption of the report.

Mr. Laurie said they were disappointed, but they must not take the disappointment too much to heart—they must expect it; it was good for them. The gas companies years ago had to pass through a similar experience. Probably the chairman and the engineer, who had recently visited the United States, with their keen intellect would have seen much which might be introduced in this country and would have a good effect upon the company's interests. He thought the West End business wanted a little waking up. He was glad to find that more capital expenditure was not required in the City.

Another Shareholder said the chairman had referred to his speeches in which he told them that the dividend would be reduced. Why, then, when they had 10 per cent. dividend did they issue shares at 100 per cent. premium? That ought never to have been done. He also wanted to know why, if they had such a large surplus, was it necessary to buy a large amount of electricity in bulk.

Mr. P. E. Pilditch said he did not understand the chairman to say that the City undertaking had made satisfactory progress as Mr. Laurie had said. He was rather under the impression that their view was that the reason why the dividend was reduced this year was that the City undertaking had not produced the results that were anticipated from it. In view of the fact that there was a sum of £350,000 from which no return, or no adequate return, had been obtained, he would like to ask them one or two questions. He saw that since last year the capital commitments of the West End Co. in favour of the City Co. had increased by roughly £100,000. Was there likely to be any increase of that sum? He supposed they could not look to any diminution until the City undertaking was really paying in every sense of the word. Was there likely to be any further capital expenditure on the City undertaking for which the West End would be responsible? That would be another serious element in deciding what dividend they were likely to get next year. Inasmuch as the City undertaking had that unproductive sum, its unproductiveness arising from lack of demand for current, could they give them any idea as to when the demand would overtake the supply or provision for supply? It was a serious point as to when they were likely to turn the corner with regard to that company, because he supposed that as soon as it paid its way and had a surplus, they would begin to get back to something in the nature of a normal dividend.

Mr. Moore pointed out that while the chairman took credit for the largely increased amount of current sold in the West End, the figures showed that the receipts had increased by £5,000, and the working expenses by £7,000. With the cheaper price of coal that must be considered unsatisfactory. An increase of business at a lower profit was not good business. Depreciation at £11,000 seemed very small indeed. At one station they had made an alteration in the machinery at a cost of £36,000, and it had been taken from the previous depreciation. The auditors' advice regarding the use of the share premiums account was bad. The Parliamentary expenses was an annual occurring event, and the money ought not to be taken from the share premium account. The ordinary shares in the Construction Co. were put down at par value. They had no balance-sheet of that Construction Co., but he thought they ought to have. In the statement of electricity generated, sold, &c., they had bought 3½ millions, and it had cost £17,000. The quantity used on works was a little more than they had bought. That was to say, that they had spent £17,600 more for current used on the works. In what way was that used on the works? In the St. James' Co. the quantity used on works was only 162,000 units, as against this company's 3½ millions. It seemed to him that that was partly where the loss of profit had gone. He could understand some loss by leakages, &c., but supposed they appeared in the "unaccounted for" column; 3½ millions seemed a tremendous lot. After a reference to the debenture bonds which mature shortly, the speaker said that the balance-sheet showed that they ought not to pay that dividend. They could not afford to spend £10,000 on that balance-sheet. They were paying 5 per cent. for their temporary advances. He had faith in the future of the undertaking, but it was wrong to run too close and get into the hands of their bankers.

Prof. W. E. Ayrton, F.R.S., said he had been looking through the speeches of former years, and he quoted from one of last year, in which the chairman referred to the increase in lights. He said that 73,000 had been added in the West End districts—that was prior to a year ago. He had said: "That is a very large number. It is the highest we have yet acquired in any one year, and it brings our grand total to 449,000; it is particularly pleasing to be able to tell you of this increase that a very considerable part was added during the past three months of the year, the effect of which, therefore, is not seen in this year's accounts, but will be seen and felt when we come before you at the end of the current year." Unfortunately, in spite of this very large increase, this extremely satisfactory condition, this company had had the perversity to go on the even tenour of its way. What did the directors think was going to happen to enable the shares to regain the value at which they were issued—100 per cent. premium? Was it an increased demand that was going to recover their lost prospects? And what would bring about the increased demand? It would not be the passing of bulk supply Bills, because they would not get that. Shareholders would like to have some idea of their views of what they thought was going to take place in the districts supplied by this company which would stop that steady falling of the dividend, because it looked at the moment as if they had only got to get a sufficiently large amount of business for the shares to be worth nothing and the dividend to go the same way.

The Chairman, in proceeding to reply to questions, said it was difficult to say exactly how many lights further they expected to get in the City, but they had relied with considerable confidence upon getting a very much larger supply in the City to come upon their mains than they had at the present moment, and he might state in reference to that that under their Act of Parliament

a schedule of streets was put upon them into which they were obliged within a given time to put their mains. In some of those streets at the present moment for practical purposes they were not supplying a single lamp, but they were streets which were considered to be sufficiently important by Parliament. In process of time they would no doubt supply them. Similarly they believed that there was a very large area in the City not supplied with electric light, and when those persons who had not got it took it, they would be receiving a dividend on their ordinary shares on the City undertaking, and would be bringing back the dividend of the whole of the company to the proportions which they all longed for. He wished he could give them the times and seasons for the increase. They had had a phenomenal increase in lamps. He did not think there had been any other company in London which had increased at the same rate of increase either in the West End or in the City, and that increase would be maintained. The City expenditure had been made with the very greatest care, and was at present lying idle. It was for the shareholders to say whether they were justified in declaring the dividend. Shareholders had the right to decrease the dividend, but they could not increase it He would strongly oppose an increase. With regard to depreciation, they had come to the conclusion that £11,000 was sufficient for their present purposes, and the writing off of £36,000 was really the capital expenditure upon the station which had fallen out of use, and they had put it as drastically as they could. In regard to the question how it was that, notwithstanding the fact that there was an increased consumption of current in the West End, the results were not so satisfactory, the answer was the decreased prices in competition with gas. If they took the number of units that they sold and multiplied it by even ½d. they would see that such a drop in the charge was a very large sum. It was that which was actually the cause of the decrease. They thought, however, that the competition price had touched bottom figure. With regard to the bulk purchase, they were obliged to keep the accounts separate, and, for economy of working, they thought it was better to buy for the West End from Bow, and similarly the City bought a certain amount from the West End when it was more economical. They had to have a dual supply available for the theatres. As to the energy used on works, any details they might want Mr. Patchell would furnish. Mr. Patchell had been to America to see what he could learn there, but he did not think he learnt much. He (the chairman) did not think the Americans were at all ahead of us; and in this particular item—loss of energy in works—the results of the company were absolutely better than some of the best stations seen in America.

Mr. Moore, interposing, said he had not wished to compare with American works, but with the St. James' Co.

The Chairman said that the conditions were altogether different. The St. James' station was situate in the middle of its area. The competition in the City was very keen, but they were holding their own; he thought that the price had been reached at which they could afford to sell, and the consumer to buy. A large number of additional lamps could be added with only the normal cost of connection, with no further expenditure on mains, machinery, &c. The suggestion that there should be a balance-sheet of the Construction Co. should receive attention. They had not yet come to the end of their capital expenditure. They were very largely in advance of the capital expenditure that could possibly be required for the City.

The report was unanimously adopted; the retiring directors and auditors were re-elected, and a resolution was passed voting 1,500 guineas to the directors for their services during the year.

A special meeting followed, at which the company's Bill was approved.

A vote of thanks to the chairman closed the meeting.

Telegraph Construction and Maintenance Co.—The report for 1905 records that Mr. William Shuter has been elected to fill the office of chairman, and Mr. Francis R. Lucas has been elected to the seat at the board vacated by the death of Sir Robert Herbert. The accounts for the year show a net profit of £73,911, after charging interest on the debentures. To this sum must be added £102,080 brought forward from last year, making a total of £175,991. The directors now propose to distribute a dividend of £1 4s. per share, being at the rate of 10 per cent., and making, with the amount already paid, a total dividend for the year of £1 16s. per share, or 15 per cent., leaving £108,760 to be carried forward. The business of the company has been satisfactory during the year, and the factories at Wharf Road and Greenwich have been fairly occupied in the manufacture of submarine telegraph cables and insulated wire. The company's steamships have been actively engaged in laying and repairing submarine cables. The *Colonia* met with an accident in striking a rock on the coast of Nova Scotia, while laying a new Atlantic cable for the Commercial Cable Co., but was fortunately got off, and was able to carry out the work on which she was employed without much delay. The *Colonia* has been thoroughly repaired, and is now in as efficient condition as ever. The *Cambria* has done excellent service during the year, and has given general satisfaction.

Dublin and Lucan Electric Railway Co.—The half-yearly meeting was held on 15th inst. at Dublin, Mr. W. Mooney presiding. The directors' report will be found on p. 189 of our February 2nd issue. The Chairman, after referring to the progress of the company, said that they had now done with the arrears of the preference dividend and the electrical equipment debt was reduced to £1,100. This capital sum they would continue to pay out of current revenue, although, personally, he would prefer that a sufficient portion of preference shares should be subscribed for, and discharge the electrical debt at once, thus expediting the period at which a dividend could be paid on the ordinary shares. The report was adopted.

Baker Street and Waterloo Railway Co.—The directors' report for the half-year ended December 31st, states that during the half-year the capital expenditure amounted to £349,620. At the half-yearly meeting sanction will be asked to the creation and issue of the share and loan capital authorised by the Act of 1904. The company's line from Baker Street to Kennington Road will be opened for public traffic during the month of March, and it is expected that the section from Kennington Road to the Elephant and Castle Station will be opened in a few months. The works from Baker Street as far as the Edgware Road are being actively pushed on. Beyond Edgware Road no work has yet been done. The company is promoting a Bill in the present session of Parliament to modify the arrangements for interchange with the Great Western system at Paddington. Satisfactory arrangements have now been made for the interchange of traffic, either by subway or footbridge, with the several companies whose lines this railway crosses. Steps are being taken to safeguard the company's interests where they may be affected by Bills now being promoted in Parliament. The meeting was held yesterday.

Crossley Brothers.—The report for last year shows a net profit of £85,600, as compared with £83,200 in 1904. The dividend on the ordinary shares is 11 per cent. and £21,800 is carried forward.

W. T. Henley's Telegraph Works Co.—Subject to audit, the directors have recommended a dividend on the ordinary shares of 15 per cent., less income-tax, including the interim dividend of 5 per cent. paid on September 1st last. The total dividend for the preceding year was at the same rate. The directors' report came to hand yesterday. The meeting is to be held on March 1st.

Shanghai Electric Construction Co.—This company held its statutory meeting at Gracechurch Street on 15th inst. The report states that the total number of shares allotted is 320 of £1,000 each, of which 317 shares have been allotted payable wholly in cash. The total amount of cash received in respect of the shares issued wholly for cash is £63,400. Payments have amounted to £53,520. Preliminary expenses are estimated at £26,000. In his speech at the meeting, Sir Alfred Dent, the chairman, said that it was anticipated that there would be no difficulty in completing the actual tramway construction in 12 months, and if the municipality were prompt in doing their portion of the work, the service should be running about that period.

National Telephone Co.—This company's meeting was held in the City yesterday.

Dick, Kerr & Co.—An extraordinary general meeting of this company was held in London yesterday.

County of Durham Electrical Power Distribution Co.—The following dividends are recommended for the year ended December 31st, 1905:—5 per cent. per annum on the preference shares, and 4 per cent. per annum on the ordinary shares.

City of London Electric Lighting Co.—The directors have resolved, subject to completion of audit, to transfer £45,500 to reserve, to pay the full rate of 6 per cent. per annum on the preference shares, and a final 7s. per share on the ordinary shares, making, with the interim dividend, a total of 6 per cent. per annum for the year. A balance of about £22,000 is to be carried forward. The ordinary dividend for 1904 was at the same rate.

Nottinghamshire and Derbyshire Electric Power Co.—A Wharncliffe meeting was held in London on 14th inst. when the company's Bill for this session was approved.

United Alkali Co.—The directors recommend a final dividend of 7s. per share, making, with the interim dividend paid, the full 7 per cent. on the preference shares for the year ended December 31st last. It is proposed to add £90,000 to the reserve funds, leaving a balance of £38,000 to carry forward.

Stock Exchange Notices. — The Committee has appointed a special settling day as under:—

Thursday, March 8th.—Electro-Peat Coal Co., Ltd.—56,000 vendors' shares of £1 each, fully paid, Nos. 8 to 43,507 and 84,296 to 96,795.

And has ordered the undermentioned to be quoted in the Official List:—

Westminster Electric Supply Corporation, Ltd.—Further issue of 3,128 4½ per cent. cumulative preference shares of £5 each, fully paid, Nos. 138,252 to 141,379; and 50,000 4½ per cent. cumulative preference shares of £5 each (issued at 7s. 6d. premium), £1 7s. 6d. paid (including 7s. 6d. premium), Nos. 141,380 to 191,379.

Prospectuses.—The *Times* says that preliminary arrangements have been made for the placing of an issue of $100,000,000 American Telephone and Telegraph Company Convertible Fours. Subscriptions will probably be invited shortly in the United States and England, and on the Continent, for part of the issue.

Barrackpore Electric Supply Co.—This prospectus was before the Calcutta public in January. The issue was of 1,000 shares, 750 being offered for general subscription at par. The company acquires from Messrs. Kilburn & Co. a licence to supply electricity at Barrackpore for public and private purposes, for a period of 42 years, after which the municipality may purchase. No contracts at the date of subscription had been entered into. Messrs. Kilburn are the managing agents and consulting engineers to the company whose office is at 4, Fairlie Place, Calcutta.

MARKET QUOTATIONS.

Wednesday, February 14th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	10½d.	..
a ,, (50 %)	per gal.	10d.	..
a Copper Sulphate	per ton	£24 10	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	200/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	2½d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£160	..
b ,, Wire, in ton lots	per ton	£191	..
b ,, Sheet, in ton lots	per ton	£177	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	9d.	..
c ,, Tube (brazed)	per lb.	10½d.	..
c ,, ,, (solid drawn)	per lb.	9½d.	..
c ,, Wire, basis	per lb.	9d.	..
c Copper Tubes (brazed)	per lb.	11¼d.	..
c ,, ,, (solid drawn)	per lb.	11½d.	..
g Copper Bars (best selected)	per ton	£93	..
g Copper Sheet	per ton	£93	..
g ,, Rod	per ton	£93	..
e ,, (Electrolytic) Bars	per ton	£92	..
e ,, ,, Sheets	per ton	£104	..
e ,, ,, Rod	per ton	£95	..
e ,, ,, H.C. Wire	per lb.	11d.	..
f Ebonite Rod	per lb.	3/3	..
,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/7	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/3½ to 5/4½	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	48/6½	3/5 dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£16 12 6 to £16 15	dec.
g ,, ,, Sheet	per ton	£18 17 6 to £19	dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 7 6	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	91/6	..
e Silicium Bronze Wire	per lb.	11d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£167 to £167 10	£2 inc.
n ,, Wire, Nos. 1 to 16	per lb.	1/11	½d. inc.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£46 to £70	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5⅝d.	..
j ,, 8 ply 10 lbs. Russian	per lb.	4½d.	..
j ,, 10 lbs. Russian, single	per lb.	4⅝d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£30 10	35/- dec.

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
j Walter H. Hindley & Co., Ltd.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Electric Power in Ironworks.—The introduction of motors of large powers is extending in connection with German mines and iron and steel works. At the Peine Works a 2,000-H.P. motor is to be installed for driving the air compressor, the order having been given to the Felten & Guilleaume-Lahmeyer Works. The Allgemeine Elektricitäts Gesellschaft are to supply motors of 10,000 H.P. for driving the rolling mills at the Hildegardenhutte, belonging to the Archduke Friedrich, at Teschen; 12,000 H.P. for the State Railway Co., at Buda-Pesth; and motors of 13,000 H.P. for the Rombach Ironworks.

STOCKS AND SHARES.

Wednesday afternoon.

"Double, double, toil and trouble," seems to be the portion of the unhappy Stock Exchange, which, if it has one day of brightness, knows full well that a week of gloom will certainly be turned on by way of equalising matters. Politics, domestic, foreign and financial—especially financial—snap at the heels of markets, causing falls, great and small, in prices all round the Stock Exchange. The lighting departments have so far come through the ordeal with creditable firmness.

Yet in the midst of the nervous tremors stirred by the slump in Kaffir shares, new issues appear and are appearing. Mention was made last week of the success of the Madras Electric Supply issue, and the Debenture stock remains at 5 premium, although the allotments are now out. We hear of many disappointed applicants. Another new electric star rises in the East; in more prosaic language, we may say that a Tokyo Electric Supply Co. will be out shortly. Nor should astonishment be felt at the appearance of one or two of the metropolitan electric supply companies in the list of capital raisers. Has not, for instance, the County of London Co. power to issue more shares? Rangoon Debenture, by the way, is not so flat as it was, being now quoted about 2 discount.

Dividends, reports and meetings somewhat agitate the electric supply market. The South Metropolitan announced a maiden dividend of 2½ per cent., but this produced no effect upon the price of the shares. Brompton Ordinary dropped ¼ to 8¾, City of London (notwithstanding the 6 per cent. dividend), Edmundsons, and Westminsters being the same fraction easier at 11¼, 4¾ and 11¼ respectively. The Notting Hill dividend came up to expectation, and the price of the shares is left at 14. London Electric Ordinary and Preference are both harder upon the company's report, but Charing Cross fail to recover any of their loss, despite the chairman's declaration that the "City" Co. was an advantage, not a drawback, to its parent. Kensingtons show 10s. fall at 10½ upon the drop in the distribution. Amongst the rises must be noticed Metropolitan Preference $\frac{1}{16}$ up at $\frac{7}{16}$, Edmundson's Preference ⅛ at 5½, and Oxfords ⅛ at 6¾. The reduced dividend of the Westminster Co. is due partly to the lower price obtained for the current, and also to law costs incurred largely in connection with the Administrative County Bill.

For London United Tramway Preference shares to have kept firm in spite of the lower dividend on the Ordinary is a testimony to the acuteness of a few people who sold before the news became known, and put the price down then. British Electric Traction Ordinary and Preference have each lost 5s., and the market is a bad one. Traction shares on the whole are steady enough. Anglo-Argentine Ordinary are a shade easier in being offered at 9. The scheme offering shareholders 12 new shares at £5 in right of every 17 old shares held has not made its appearance yet. Buenos Ayres Grand National "A" Preference are still at 7¾, and the directors will, no doubt, carry their proposals, although the Ordinary proprietors are called upon to make some considerable sacrifice as regards dividend and capital. Both Westinghouse Preference have hardened a little, being 2⅛, after losing that important fraction. Cape Electric Trams are ⅛ lower at ⅝.

Central London Preferred rose a point to 104, while Waterloo and City added 2, upon the purchase considerations. City and South London sticks at 42, and the Third Preference (1901) stock stands about 114½. Metropolitans are 82, and Districts 50 points less. London General Omnibus has suffered another severe fall upon the proposal to create Preference shares.

Telegraph stocks merely mark time. It is something for them to do that, seeing how other markets are falling away. The Anglo "A" speculation swings this week in favour of the bulls, the price showing a ⅜ rise at 18½. The stock causes immense excitement, occasionally, in the Miscellaneous Market. Eastern Telegraph Preference eased off a further ½, while the Ordinary rose a point, and Marconi's are another ½ lower at 1½, thus returning to about the price at which they stood before their recent "boomlet." National Telephone varieties have barely moved, but Oriental Telephone Ordinary at $1\frac{5}{16}$ are a shade lower.

Recent demand for Telegraph Construction shares is explained by the report now available, which shows an increase in the profit for the year of 50 per cent. The dividend remains at 15 per cent., and the price of the shares fell ½ to 35. Manufacturing issues are rather better. Edison & Swan Ordinary are ⅛ up at 1¾, and the Preference ¼ at 2¾, these being the only quotable alterations. The India-Rubber Co. is about to issue a large amount of 4 per cent. Debentures to replace the existing amounts, and First and Second 5 per cent. Debentures now due to be redeemed.

So much has lately been spoken and written upon the subject of the terms at which electric lighting undertakings can be taken over by local authorities, that the references to it at the meeting of the Charing Cross meeting are worth attention. The chairman was dealing with the "City" Company, which appears to be governed by special conditions, but he referred incidentally to other lighting concerns, and his remarks should be read by all who are interested.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905. §	Closing Quotations Feb. 14th.	Closing Quotations Feb. 21st.	Business done week ended Feb. 21st, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	98½ —101½	98½—101½	99	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	3⅜— 4⅛	3⅜— 4⅛	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2⅜%	3½%	64 — 66 xd	64 — 66	65½	..	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅝%	6 %	110½—111½xd	111½—112½	112	110½	· +1
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	⅛%	18 — 18½xd	18⅜— 18⅝	18⅜	18⅛	+ ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	102 —104	102 —104	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	8 — 8½	8 — 8½	..	..	..
1,932,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	98⅜	98	..
16,090	Cuba Telegraph	10	6¾%	10 %	5 %	5 %§	8½ — 9	8½ — 9	8⅝	8	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %§	17 — 18	17 — 18	17⅜	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %§	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %§	8½— 8⅝	8½— 8⅝	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99 —102	99 —102 %	..	..	..
60,712£	Direct United States Cable	20	3¼%	3 %	3¾%	3⅜%	14½ — 15½	14⅜— 15½	15⅜	14⅞	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	5 %§	148 —151	149 —152	150½	149	+1
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%§	91½ — 93½	91 — 93	92	91	— ½
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %§	107⅛—109½	107⅛—109½	109	108½	..
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 %§	14⅜— 15⅛	14⅜— 15⅛	15⅛	14⅜	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %§	105 —107 xd	105 —107	106⅜	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	100½	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103 %	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5⅛%	5⅜%	5 %	11⅛— 11⅜	11⅛— 11⅜	11⅛	11⅛	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 14⅝	14⅜— 14⅝	14⅝	14⅜	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	..	37½— 39½	37 — 39	38½	38¼	— ¼
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	5 %	57 — 59	57 — 59	..	..	..
251,127	Marconi's Wireless Telegraph	1	..	..	..	..	1⅛— 1⅜	1⅛— 1⅜	27/6	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	⅞— 1	⅞— 1	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞— 1	⅞— 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	113½—114½	113⅝—114½	114½	113½	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	110 —112	110 —112	111½	110	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	13 — 15	13 — 15	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜— 5¾	5⅜— 5⅞	5 7/16	5⅛	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99½—101½	99 —101	99⅝	99½	— ½
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103½—105½	103½—105½	104½	..	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¾%	6¾%	6 %	1⅝— 1⅞	1⅝— 1⅞	26/3	25/7½	— 1/6
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅝— 1⅞	1⅝— 1⅞	21/10½	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %§	7⅞— 7⅞	7⅞— 7⅞	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 —106	103 —106	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7¾— 7⅞	7¾— 7⅞	7 7/16	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅝— 5⅞	5⅝— 5⅞	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —112	111½	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9½— 10	9½— 10	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	⅜— ½	⅜— ½	13/4½	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14½ — 15	14½ — 15	14⅝	..	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜— ⅝	⅜— ⅝	10/-	9/9	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8½— 8⅞	8½— 8⅞	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6½— 7½	6½— 7½	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	6 %§	8⅞— 9⅛	8⅞— 9⅛	9 1/16	8⅞	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅝— 6⅛	5⅝— 6⅛	6 1/16	5⅝	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	141 —144	141 —144	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	105	104½	..
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	16 %‖	3⅞— 4⅛	3⅞— 4⅛	81/3	79/1½	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅞— 1⅞	1⅞— 1⅞	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	..	..	1⅝— 2⅛	1⅝— 2⅛	41/3	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	Nil	3/6	5⅛— 6	5⅛— 6	5⅛	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	3/-	5 — 5⅛	5 — 5⅛	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	3 — 3⅛	2⅞— 3⅛	65/-	58/9	— ⅛
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	98 —102	98 —102	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	..	120 —123	120 —123	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	..	110 —113	110 —113	111½	111½	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	108 —111	108 —111	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105%	103 —105 %	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	7⅜— 8⅛	7⅜— 8	7⅞	7⅛	— ⅛
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	10⅜— 10⅝xd	10 — 10⅜	10⅜	10⅛	— ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	119 —121	119 —121	120⅛	119⅛	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	98 —100	98 —100	98⅛	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %§	6⅞— 7⅛	6⅞— 7⅛	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %§	5⅞— 6⅛	5⅞— 6⅛	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	98 —100	98 —100	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞— 2⅛	1⅞— 2⅛	45/-	..	+ ⅛
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 82	77 — 82	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	½— ¾	½— ¾	12/9	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1½— 2	1½— 2	35/9	33/9	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	83½	82½	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	..	8⅜— 8⅞	8⅜— 8⅞	76/3	75/7½	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	..	5⅞— 6⅛	5⅞— 6⅛	..	..	..
27,500	Do. "B" do. 1 to 27,500	5	..	6 %	6 %	..	5⅛— 5⅜	5⅛— 5⅜	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107	105 —107	106	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	7 %§	9½— 10	9½— 10	9⅝	9 11/16	..
32,610	Do. 105,001 to 137,610	5	..	..	..	3d.	9 — 9¼	9 — 9¼	9 3/16	9	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4 %	4½%	104 —106	105 —107	106⅜	..	+ 1
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	11 — 12	11 — 12	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5 5/16	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	103½—110¼	103½—110¼	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	¾— 1⅛	¾— 1	..	..	— ⅛
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1⅝— 1⅞	1⅝— 1⅞	21/10½	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 —100	95 —100	..	..	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	93 — 95 xd	93 — 95	94	92⅞	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	102 —104 xd	103 —105	104⅛	..	+ 1
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	83 — 86 xd	83 — 86	84	83	..
1,480,000	City and South London Railway	Stock	3½%	2½%	2½%	1⅞%	41 — 43 xd	41 — 43	43⅛	42	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	2½%	..	2 — 2⅛	2 — 2⅛	42/6	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98 %	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	§1905.	Closing Quotations Feb. 14th.	Closing Quotations Feb. 21st.	Business done week ended Feb. 21st, 1906. Highest.	Lowest.	Rise + or Fall−
52,000	Dick, Kerr & Co., 1 to 52,000	£5	..	..	10 %		8½ — 9	8½ — 9	..	..	..
61,000	Do. do. 6 % Cum. Pref., 1 to 61,000	£5	..	6 %	6 %	6 %	6 — 6¼	6 — 6¼	6⅝	6⅜	..
294,150	Do. do. 4½ % Deb. Stock	£100	..	4½ %	4½ %	4½ %	104 —106	104 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	£10	..	5⅓ %	6 %	6 %	13⅜ — 14⅜ xd	13⅜ — 14⅜ xd	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	£10	..	6 %	6 %	6 %	14½ — 15½ xd	14½ — 15½ xd	..	..	..
63,400	Do. 4 % Debs.	£100	..	4 %	4 %	4 %	99½ —100⅝	99 —101	..	..	— ½
300,000	Do. 3½ % "A" Debs.	£100	..	3½ %	3½ %	3½ %	99 —101	98 —100	..	..	-1
300,000	Do. 3½ % "B" Deb. Stock	£100	..	3½ %	3½ %	3½ %	97 — 99	97 — 98	..	..	— ½
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	£5	Nil	Nil	2½ %§	..	1½ — 1⅝	1⅝ — 1⅞	33/9	31/9	+ 2/6
17,139	Do. "A" shares, 01—017,139	£5	Nil	Nil	2½ %§	..	2½ — 2¾	2⅓ — 3	52/9	50/7½	+ 1
344,023‡	Do. 4 % Deb. Stock Red.	£100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	86½	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	£100	5 %	5 %	5 %	5 %	92 — 97	92 — 97	..	..	..
112,100	Electric Construction 1 to 112,100	£2	6 %	4 %	Nil	..	⅛ — ⅜	⅛ — ⅜	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	£2	7 %	7 %	7 %	..	2 — 2⅛	2 — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	£10	5 %	5 %	5 %	..	9⅛ — 9⅜	9⅛ — 9⅜	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	95 — 99	95 — 99	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	£10	..	3 %	4 %	4 %	4⅜ — 5⅛ xd	4⅜ — 5⅛ xd	5	98/9	..
96,000	Greenwood & Batley 7 % Cum. Pref.	£10	..	7 %	7 %	7 %	10⅝ — 11¼	10⅝ — 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	£100	..	5 %	5 %	5 %	102 —104	102 —104	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	£5	20 %	15 %	15 %	15%	13 — 14	13 — 14	13⅛	13	..
200,000	Do. do. 4½ % Pref.	£5	4½ %	4½ %	4½ %	4½ %	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5⅛	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	.. — ..	.. — ..	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	£10	10 %	10 %	5 %	10%	18 — 19	18 — 19	18⅜	18 1/16	..
800,000‡	Do. do. 4% 1st Mort. Deb.	£100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	£10	1¾ %	1⅜ %	1½ %	Nil	1⅛ — 2⅛	1⅞ — 2⅛	..	..	..
10,000	† Do. do. Pref. £10 paid	£10	5 %	5 %	5 %	5 %	6⅜ — 6¾	6¼ — 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	£10	..	8 %	6 %	3 %	9⅜ — 10⅜	9⅛ — 10⅛	..	..	..
399,930	Do. do. 60,008 to 100,000 (£4 paid)	£10	..	8 %	6 %	3 %	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	£10	..	5 %	5 %	5 %	9 — 9⅛	9 — 9⅛	9⅛	9⅛	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	£100	..	4 %	4 %	4 %	93 — 96	94 — 97	95¼	93¼	+1
314,016	Metropolitan Electric Trams, Defd.	£1	Nil	Nil	Nil	..	7/32 — 9/32	7/32 — 9/32	..	..	..
500,000	Do. 5 % Cum. Pref.	£1	5 %	5 %	5 %	5 %	1 — 1 1/16 xd	1 — 1 1/16 xd	20/3	19/9	..
350,000	Do. 4½ % Deb. Stock Red.	£100	..	..	4½ %	4½ %	104—106	104 —106	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	£5	..	..	6 %	6 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	£10	..	5 %	5 %	..	8⅜ — 9⅛	8⅜ — 9⅛	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	£10	..	5 %	5 %	5 %	9⅛ — 10	9⅛ — 10 xd	..	..	..
245,000	Do. 4½ % Deb. Stock	£100	..	4½ %	4½ %	4½ %	103 — 106	103 —106	..	..	..
37,350	Telegraph Construction and Maintenance	£12	20 %	20 %	15 %	15 %	34½ — 36½	34 — 36	35¼	34	— ½
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	£100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	98 — 100	98 —100	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	£100	3⅛ %	3⅛ %	3⅛ %	3⅛ %	97 — 100	99 —102	101	..	+2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	£5	8⅓ %	6 %§	..	..	2¼ — 2⅜	2¼ — 2⅜	46/3	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	£5	..	6 %	..	..	4 — 4¼	4 — 4¼	85/-	82/6	..
246,806	Do. 4 % 1st Mort. Deb. Stock	£100	..	4 %	4 %	4 %	82 — 87	82 — 87	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	£5	..	5 %	5⅛%	4 %§	5¼— 5⅝	5¼— 5⅝	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	£100	..	4½ %	4½%	4½%	103 —106	103 —106	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	£5	8 %	10 %	10 %	9 %	8¾— 9¼	8¾— 9¼	9	8⅞	..
10,623	Do. do. 7 % Cum. Pref.	£5	7 %	7 %	7 %	7 %	8⅝— 9⅛	8⅝— 9⅛	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	£100	4 %	4 %	4 %	4 %	102 —105	102 —105	102¼	..	..
80,000	Charing Cross and Strand Electricity Supply	£5	10 %	8 %	8 %	5 %	5 — 6	5 — 6	5⅛	5¼	..
80,000	Do. do. do. 4½ % Cum. Pref.	£5	4½%	4½%	4½%	4½%	5 — 5⅛ xd	5 — 5⅛ xd	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	£5	4½%	4½%	4½%	4½%	4¼ — 4⅜	4¼ — 4⅜	..	..	..
40,000	Do. do. 1903	£5	..	4½%	4½%	4½%	4¼ — 4⅜	4¼ — 4⅜	..	..	..
120,000	Do. do. 4 % Deb. Stock Red.	£100	4 %	4 %	4 %	4 %	101 —103	101 —103	102⅜	..	..
44,496	Chelsea Electricity Supply, Ord.	£5	4½%	5½%	6 %	6 %	5 — 6	5 — 6	5⅜	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	£10	5 %	5 %	6 %	5 %	11 — 12	10⅞ — 11⅞	11 3/16	11⅛	— ⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£10	6 %	6 %	6 %	6 %	13⅛ — 14⅛	13⅛ — 14⅛	..	..	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —126	123 —126	125⅛	124⅛	+ ½
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	£100	4½%	4½%	4½%	4½%	100 —102	100 —102	101⅛	..	..
40,000	County of Durham Electrical Power, Ord.	£2	..	..	..	..	1⅞ — 2	1⅞ — 2	..	..	..
50,000	Do. do. do. 5 % Pref.	£5	..	..	..	..	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£10	4 %	4 %	4½%	4 %§	8⅛ — 9⅛	8¾ — 9⅛	9⅛	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	£10	6 %	6 %	6 %	6 %	12⅝ — 13	12⅝ — 12⅞	12⅞	12½	— ⅛
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	102½	101⅓	..
80,000	Edmundson's Electric Corporation, Ord. Shares	£5	7 %	7 %	7 %	5 %§	4⅜ — 5¼	4⅜ — 5	..	..	— ¼
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5¼ — 5⅝	5¼ — 5⅜	5 7/16	5⅜	+ ⅛
320,000	Do. do. 4½ % 1st Mort Deb. Stk	£100	4½%	4½%	4½%	4½%	104 —106	104 —106	104 1/16	104¼	..
10,000	Folkestone, 1 to 10,000	£5	..	5½%	5½%	4 %§	5¼— 5⅜	5¼— 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	£5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	£100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	£5	..	8½%	8½%	8 %	8¼ — 8⅜	8¼ — 8⅜	..	..	..
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	8 %	8 — 8⅛	8¼ — 8⅜	..	..	+ ¼
37,303	Do. 4 % Deb. Stock	£100	..	4 %	4 %	4 %	98 —101	98 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	£100	..	4½%	4½%	4½%	98 —101	98 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£5	10 %	12½%	12 %	10 %	10½— 11¼	10 — 11	..	..	— ½
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	103¼	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£3	Nil	Nil	3 %	4 %	2 — 2⅛	2¼ — 2⅜	50/7½	..	+ ¼
60,000	Do. do. do. 6 % Pref.	£5	6 %	6 %	6 %	6 %	5¼ — 5⅝	5⅝ — 5⅝	5⅝	5 11/16	+ ⅛
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	£5	7½%	8⅜%	10 %	10 %§	9 — 10	9 — 10	9 7/16	9 3/16	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	£5	4½%	4½%	4½%	4½%	5¼— 5½	5 7/16— 5 9/16	5⅝	..	+ 1/16
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	107 —111	109 —113	..	..	+2
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	£100	4½%	4½%	4½%	4½%	100 —103 %	101 —103 %	102½	..	+ ½
57,009	Newcastle-on-Tyne, 1 to 57,009	£5	..	8 %	8 %	2½%§	8 — 8½	8 — 8½	..	..	..
17,991	Do. 57,010 to 75,000	£5	..	..	..	2½%	8 — 8½	8 — 8½	..	..	..
57,009	Do. 5 % Pref., 1 to 57,009	£5	..	5%	5	5 %	6½ — 6⅝	6½ — 6⅝	..	..	..
17,991	Do. 57,010 to 75,000	£5	..	..	..	2½%	6½ — 6⅝	6½ — 6⅝	..	..	..
10,852	Notting Hill Electric Lighting	£10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	..	..	..
64,000	Do. do. 4 % 1st Mort. Deb.	£100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	£5	..	6½%	7 %	7 %	6⅝ — 6¾	6½ — 7	..	..	+ ⅛
50,000	Do. 4 % Deb. Stock	£100	..	4 %	4 %	4 %	98 —100	99 —101	..	..	+1
40,000	St. James' and Pall Mall Electric Light, Ord.	£5	14½%	14½%	14½%	12½%	11 — 12	11 — 12	11⅜	11¼	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	£5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	£100	3½%	3½%	3½%	3½%	97 — 99	97 — 99	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£5	2½%	4 %	4 %	4 %	2⅜ — 3½	2½ — 3	..	..	— ⅛
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80 xd	76 — 80 xd	..	..	..
65,000	South London Electricity Supply, Ord.	£5	12½%	3 %	4 %	..	3⅜ — 3⅝	3⅜ — 3⅞	..	..	— ⅛
103,700	South Met. Elec. Lt. & Power (Ord.	£1	Nil	Nil	Nil	2½%	7/16 — ½	7/16 — ½	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	£1	Nil	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	£100	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..
50,000	Urban Electric Supply, Ord.	£5	5 %	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..
30,000	Do. do. 5 % Cum. Pref.	£5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5⅛	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	£100	..	..	4½%	4½%	104 —106	104 —106	..	..	..
110,000	Westminster Electric Supply, Ord.	£5	12 %	13½%	14 %	13 %	11 — 12	10⅜ — 11⅜	11 1/16	10⅛	— ⅛
28,151	Do do. 4½ % Cum. Pref.	£5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5 13/16	..	..

Shares not officially quoted :—Mackay Companies, ord., 61—62. Pref. 74—77.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 4 per cent. (September 28th, 1905).

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JANUARY, 1906.

THE feature of the January returns of electrical exports and imports is undoubtedly the sudden rise in the latter, which reached the highest value recorded during the past 12 months, viz., £157,369. For the month the totals were: Exports, £114,509; imports, £157,369; and re-exports, £8,747; which compare with £122,648, £135,002, and £8,754 respectively, for the same items in the month of December last.

Our export business has thus declined during the month to the extent of some £8,000, the items of cables and machinery alone accounting to some £10,000 decrease, while other items show slight improvement—bringing the total to the figure given.

Turning to the imports again, striking increases are recorded in the value of cables, lamps, machinery, carbons and telegraph and telephone material, entering this country; in the matter of telephones, Sweden and Belgium each contribute upwards of £9,000 worth to the total of £19,974 recorded in that section, and this compares with our own meagre home-made export of £890 in value.

The imports classified as electrical goods and apparatus, however, show a drop of some £21,000 in value.

One small item of tramway material figures in the exports, which do not vary much from preceding returns in destination.

Assuming that the bulk of the Dutch imports are of German origin, it is apparent that the latter country takes precedence in the matter of electrical imports, while the United States makes a good second.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	67	...	5	3	...	870	...	...	...	6	...
Germany	299	1,000	...	...	16	433	...	...	30	10	...
Netherlands	78	690	671	...	...	720	4	...	153	123	...
Dutch Borneo and Java	19	...	..	112	7	4	...	...	...	...	...
Belgium	129	60	83	2	34	726	2	...	233	...	...
France	276	...	3	17	60	1,079	65	57	...	...	...
Portugal, Madeira and Portuguese East Africa	511	472	123	23	210	1,028	...	...	22	...	...
Spain and Canary Isles	16	127	15	79	120	208	...	...	5	...	...
Italy and Austria-Hungary	17	...	...	...	1,083	199	...	...	...	...	...
Greece	..	...	...	128	13	60	...	...	...	...	...
Egypt	192	391	40	146	...	456	2	9	90	...	...
China and Siam	113	2,162	417	29	38	524	...	27	...	29	...
Japan	1,611	1,002	14	...	303	5,046	...	...	...	12	...
U.S.A. and Cuba	326	...	1,015	8	...	1,350	...	...	...	...	...
Mexico, Peru and Uruguay	17	...	50	17	...	596	...	...	...	...	...
Chili	56	145	94	87	165	24	34	13	...	...	...
Brazil	...	...	10	66	...	188	20	...	29	655	...
Argentine	1,897	1,888	599	105	89	6,299	577	11	137	8,685	...
Channel Isles, Gibraltar and Malta	73	482	38	45	29	598	...	...	...	159	...
British West Africa	2	10	48	...	24	...	52	...	15	393	...
Cape of Good Hope	2,983	1,883	448	342	173	1,795	39	...	...	...	...
Natal	1,432	2,460	2,192	355	1,431	8,903	59	...	7	1,005	...
Zanzibar, British East and Central Africa, Mauritius and Aden	3	...	71	6	165	1,295	...	...	77	73	...
India	3,293	3,569	3,155	398	1,078	7,748	316	75	77	900	2,260
Burmah	12	17	49	...	...	...	23	...	2	...	...
Ceylon	46	27	239	...	5	61	53	...	...	...	...
Straits Settlements, Malay States and Sarawak	109	48	312	...	5	264	14	7	...	43	...
Hong Kong	311	434	116	22	...	52	32	...	3	...	...
West Australia	178	...	172	341	306	129	..	...	3	36	...
South Australia	136	...	...	...	...	17	29	...	...	...	...
Victoria	509	394	36	...	66	124	125	...	...	...	...
New South Wales	723	964	228	295	43	1,710	66	...	...	114	...
Queensland	...	420	...	...	...	220	20	...	5	...	...
Tasmania	8	...	...	...	...	...	...	...	...	...	...
New Zealand	365	1,550	471	144	...	353	68	6	11	77	...
Canada	18	...	60	...	...	967	...	...	...	...	...
British West Indies and British Guiana	112	...	25	11	...	...	...	...	...	...	..
Total, £	15,940	20,195	10,799	2,781	5,463	44,046	1,601	205	890	12,320	2,260

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Norway, Sweden and Denmark	1,982	...	...	87	...	1,675	45	...	8,739	...	...
Germany	4,272	11,535	1,099	228	...	14,265	778	969	1,171	...	...
Holland	4,243	6,003	359	4,971	13	1,518	493	8,316	832	5	...
Belgium	3,918	2,581	229	4,454	100	3,297	60	2,344	8,967	...	...
France	3,617	5,246	434	385	1,578	826	719	2,815	231	...	...
United States	4,771	5,876	704	111	...	25,767	377	602	34	294	...
Canada	14	...	...	...	...	3,270	...	...	...	...	...
Total, £	22,817	31,241	2,825	10,236	1,691	50,618	2,472	15,046	19,974	299	...

Additional Imports: Italy, cable, £70; Austria-Hungary, carbons, £80.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	2,712	1,700	132	2	22	2,841	42	88	698	2	8

TOTAL EXPORTS: £114,509

TOTAL RE-EXPORTS: £8,747

TOTAL IMPORTS: £157,369

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

PROCEEDINGS OF INSTITUTIONS.

Technical Considerations in Electric Railway Engineering.

By F. W. CARTER, M.A., Associate Member.

(*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *London, January 25th*, 1906.)

IT is proposed in the present paper to deal in a general way with the technical side of the electrification problem, neither entering, to any great extent, on the larger questions of economic engineering nor including descriptions of apparatus and material.

In the course of the paper the author will give details of the methods employed in investigating the preliminary and exact engineering features of the electrical system, basing his work, for the most part, on the use of continuous current railway motors, as applied to suburban service under conditions obtaining in this country. The methods employed will, however, be quite general, and applicable to other systems than that particularly considered.

The engineering problen should be attacked in a strictly logical manner. Beginning with the requirements of the system in respect to the moving of passengers or goods, a suitable train-driving equipment is first determined. The power and energy consumption of the train are then computed and the daily traffic estimated. Afterwards the generating plant and distributing system are laid out to suit the traffic requirements.

The chief classes of service between which it appears necessary to distinguish for the purpose of this paper are: (1) urban and suburban, (2) branch line and inter-urban parliamentary, (3) long-distance express, (4) goods. These differ in their requirements chiefly with respect to (1) rate of acceleration and speed up to which it is necessary to maintain the maximum rate, (2) behaviour on grades, (3) maximum speed attainable on level track. The chief electrical systems available for railway service are: (1) the continuous current system, (2) the single-phase alternating current system, (3) the polyphase system employing induction motors.

The effect of the motors on the train depends upon (1) weight of train, (2) inertia of rotating parts, (3) train resistance.

The weight of train to be employed in calculating the acceleration due to any force is a certain spurious "effective weight," composed of the true weight and an increment due to the rotation of the wheels and armatures. This increment is not difficult to obtain and will be merely stated here. If w be the weight of a wheel, r its radius at the tread, and k its radius of gyration, the increment of weight due to the rotation of the wheel is $w\left(\frac{k}{r}\right)^2$. In an average steel railway wheel $\left(\frac{k}{r}\right)^2 = 0{\cdot}6$ approximately. If w' be the weight of an armature, r' its radius, k' its radius of gyration, and γ the ratio of gear reduction, the increment of weight due to the rotation of the armature is $w'\left(\gamma\frac{k'}{r}\right)^2 = w'\left(\gamma\frac{k'}{r'}\frac{r'}{r}\right)^2$. For a continuous-current armature $\left(\frac{k'}{r'}\right)^2 = 0{\cdot}5$ approximately. Thus if w = 800 lb., w' = 1,600 lb., $\gamma = 3$, $\frac{r'}{r} = \frac{1}{2}$, the addition for rotary inertia will be approximately 480 lb. per wheel and 1,800 lb. per armature.

In the case of suburban trains operated by continuous-current motors, the amount to be added on account of rotary inertia will usually be some 8 or 10 per cent. of the weight of the train, whilst with single-phase alternating-current motors the increment may amount to double as much, on account of the greater number and weight of armatures and their generally higher peripheral speed.

The forces resisting the motion of the train consist of the easily calculated positive or negative component due to grade—proportional to the actual weight of the train—and the rather uncertain "train resistance," composed of journal and flange friction, air resistance, &c. There is a lack of reliable data on the resistance offered to the motion of electric trains, which it is hoped will soon be supplied. The classical results of Aspinall* were obtained from measurements made behind a locomotive and tender, and accordingly do not include the head resistance, which is a very important element in the case of electric trains of two or three coaches. The Berlin-Zossen† high-speed train resistance tests were made with a single coach of totally different type to those usually employed in this country. Pending the publication of more suitable data, the author has combined the results of the above mentioned sets of tests to obtain the working curves of fig. 1, which he has found to agree very fairly with the results of such isolated tests on electric trains as he has been able to make. The variable portion is expressed in terms of the dimensions of the train, rather than of the weight, since it must represent principally air resistance, and therefore at any speed can depend only on the external configuration of the train. The constant portion of the resistance, which is taken from the above-mentioned tests at such low speeds that the static resistance just ceases to be apparent, is probably expressed with sufficient accuracy as proportional to the weight, and appears to be 2½ lb. to 3½ lb. per ton. The total train resistance is therefore the amount deduced from the curves of fig. 1, increased by 2½ to 3½ lb. per ton.

* *Proceedings* Institution of Civil Engineers, Vol. cxlvii., p. 155.

† *Proceedings* Institution of Electrical Engineers, Vol. xxxiii., p. 894.

A light train of given external dimensions will, except at low speeds, meet with almost as great a resistance as a heavier built one of the same dimensions. A train of many coaches experiences much less resistance per coach or per ton than one of two or three coaches, particularly at high speeds. These facts are allowed for in the curves of fig. 1. A long-distance high-speed train should, for efficiency, be composed of many coaches, whilst the weight is a secondary consideration. A frequently stopping low-speed train, on the other hand, should be built light, but whether it is composed of few or many coaches is of small importance as far as efficiency is concerned.

The resistance due to the friction of brushes, motor journals and gears, is usually charged to the motors, the tractive effort of which is supposedly measured at the rims of the driving wheels. It

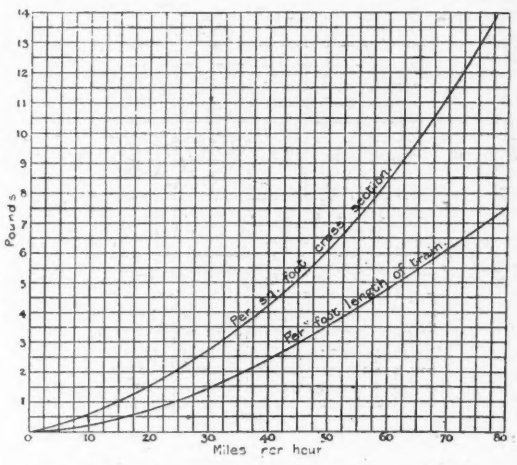

FIG. 1.—TRAIN RESISTANCE CURVES GIVING THE VARIABLE COMPONENT OF TRAIN RESISTANCE.

accordingly does not affect the train resistance during the time when power is being supplied to the motors, but should be included during the time of coasting or drifting.

Of the energy supplied to the train, part is dissipated in motors and controlling apparatus, part is employed in overcoming train resistance, whilst the remainder imparts kinetic energy to the train and is dissipated during braking. The proportions of the several components are shown in fig. 4 for typical suburban service employing continuous current motors. The energy required to overcome train resistance amounts very nearly to two watt-hours per ton-mile for every pound per ton train resistance. The kinetic energy dissipated during braking varies as the effective weight of the train, and as the square of the speed when brakes are applied. The energy dissipated in motors and gears will be some 10 or 12 per cent. of the input, whilst from 6 to 12 per cent. will usually be dissipated in starting rheostats. In the single-phase system the losses in motors, gears and controlling apparatus, will usually be at least as great per ton-mile as in the motors, gears and rheostats, of the continuous current system, chiefly on account of the much lower efficiency of the motors. It will be seen that, in suburban work, a considerable fraction of the energy is dissipated during braking. In order to reduce this, suburban trains should be built as light as practicable, and run at as low a maximum speed as is consistent with the required schedule speed. A high rate of accleration and a high rate of braking retardation are therefore desirable, since with these given the maximum speed can be kept down without diminution of schedule speed. As a general rule the best gear to employ with the motors is the lowest speed gear that will perform the service with a suitable margin for eventualities, provided, of course, that there is sufficient weight on driving wheels to stand the high accelerating tractive effort of a low-speed gear. The energy consumption is considerably affected by the rate of acceleration, particularly when stops are frequent and speeds high.

Whilst discussing energy consumption, it might be well to issue a warning against the abuse of the ton-mile basis. As long as we deal with a particular system of electrification, the energy consumption is well expressed in watt-hours per ton-mile, but in comparing different systems with one another, it should not be overlooked that the weight of train incident to a system is also a factor in the energy consumption.

The continuous-current railway motor is characterised by the fact that within the limits of practicable and efficient operation it has a large range of torque and a moderate range of speed. As usually geared, it is possible to obtain a torque of ten to fifteen times that required to overcome the train resistance at the maximum speed attained on the level, the high torque being maintained until the speed reaches approximately a half of the maximum. The characteristics of this motor, however, are well known and need not be further discussed here.

The polyphase induction motor is also well understood. Its efficient range of torque is moderate and the corresponding range of speed very small.

Single-phase alternating-current railway motors are of two general types—the compensated series and the repulsion type. The

former is characterised by having its range of practicable and efficient operation between synchronous speed and two or two and a half times as much; whilst the latter operates below and up to synchronous speed, above which the commutation is bad. Both types show the same general speed-torque characteristics—the range of torque being considerably smaller and the range of speed somewhat greater than in the continuous-current railway motor.

Fig. 2 shows typical speed and tractive effort curves for the continuous current, the single-phase alternating current, and the polyphase induction motor.

Knowing the train resistance, grade, and tractive effort of the motors at any speed, we can deduce the tractive effort available for producing acceleration, whence—from the effective weight of the train—the rate of accleration. It is now a question of simple dynamics to deduce speed-time and speed-distance curves, whilst from the motor characteristics the power-time, current-time and other train characteristic curves may be deduced.

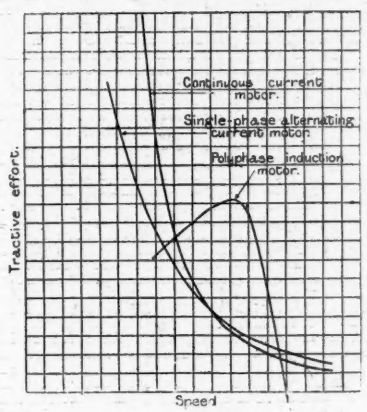

FIG. 2.—COMPARATIVE SPEED AND TRACTIVE-EFFORT CURVES OF RAILWAY MOTORS.

The schedule that a given train is capable of, or the equipment required to maintain a given schedule, can generally be very closely computed by assuming as the distance between stops the average of the several actual distances, and, furthermore, assuming the track to be level. Both schedule speed and energy consumption will be nearly the same for this average run as the schedule speed and average energy consumption deduced from the actual runs. Unless and until conditions are fully known, it is not, in the majority of cases, worth the labour to compute train characteristics for the actual runs.

If there is considerable difference of level between terminal stations, the averages in the foregoing statement must be assumed to apply to runs in both directions along the line. Moreover, the stations are supposed to be promiscuously distributed with respect to the grades.

The typical schedule run may be divided into four elements, corresponding respectively to (1) acceleration to the speed curve; (2) speed curve running; (3) coasting; and (4) braking. Since any of these elements can be varied, it follows that a run can be made

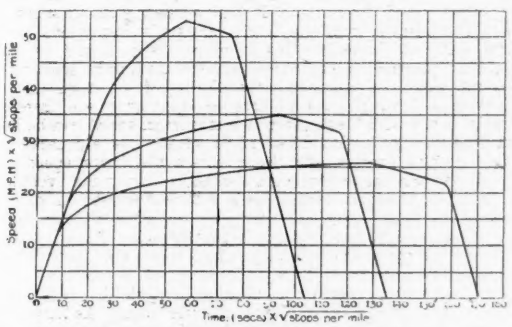

FIG. 3.—TYPICAL TRAIN CHARACTERISTICS FOR TRAINS OPERATED BY CONTINUOUS CURRENT.

in many different ways. However, for any particular type of motor, if average values be assumed for the amount of coasting and rate of braking, the remaining variables can, for practical purposes, be expressed in a system of curves, from which the particulars and performance of the train can be deduced.

Fig. 3 shows typical train characteristics corresponding to acceleration at 1·5 miles per hour per second. The three curves are of the same area, and the distance represented will be found to be one mile divided by the number of stops per mile, as of course it should be.

Fig. 4, showing how the energy input is finally dissipated, practically explains itself. It will be seen that with little speed-curve running the loss in braking predominates, whilst with much speed-curve running the energy is principally employed in overcoming train resistance. In other words, where stops are frequent the total energy consumption depends largely on the weight of the train, and where infrequent on the train resistance. Series-parallel motor-control is, of course, always assumed in these curves.

The power output of the motors during a run is very variable. It starts at zero and rises with the speed during the period of acceleration on resistance. Then, with the speed still rising, but more slowly, it falls off continually due to decrease of tractive effort. The maximum power will be developed at the instant when all resistance is cut out, with motors in parallel—that is, when the motors are taking the accelerating current at full voltage. It will usually, though of course not necessarily, be approximately the rated horse-power according to the rule of the American Institute of Electrical Engineers given in the next section. This rule was, in fact, devised in order to provide a good test for the motors at the normal accelerating current—that is, the average maximum current at which the operation must be perfectly satisfactory. With the horse-power reckoned in the above manner, the weight of the electrical equipment is taken as 40 lb. per horse-power. This is an average figure for the weight of motors and controlling apparatus employed in suburban service, which must, of course, only be treated as a first approximation.

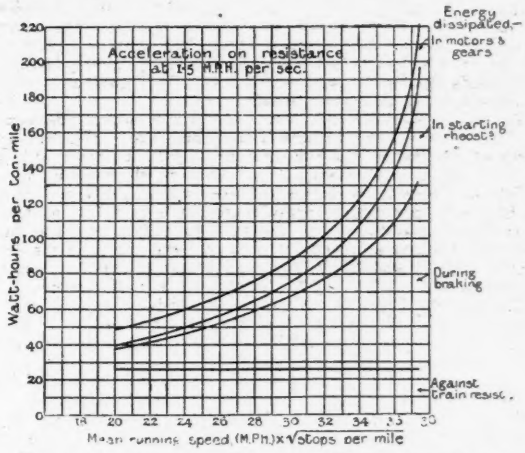
Energy dissipated—
In motors & gears
Acceleration on resistance at 1·5 M.P.H. per sec.
In starting rheostat
During braking
Against train resist.
Watt-hours per ton-mile
Mean running speed (M.P.H.) x √stops per mile

FIG. 4.—DISSIPATION OF ENERGY IN TRAINS OPERATED BY CONTINUOUS CURRENT.

We are now in a position to estimate the weight of the train and the total power of the equipment, and to determine the power and number of the motors. A little trial and adjustment may be necessary, as the equipment will be heavier than the above figure (which is based on 150-H.P. to 175-H.P. motors), if many motors of small power are employed, whilst motor trucks are considerably heavier than trailing trucks. Moreover, the weight on driving wheels must be determined before the equipment can be finally settled on, in order to discover whether the adhesion is sufficient to stand the tractive effort of the motors. The accelerating tractive effort should not exceed about 17 per cent. of the weight on driving wheels in the case of trains driven by motor-cars, operated by the multiple-unit system of train control—wherein it is impracticable to sand the rails in front of all driving wheels in bad weather. Where locomotives are used, however, the average accelerating tractive effort may be allowed to amount to 24 or 25 per cent. of the weight on driving wheels, if efficient provision is made for sanding the rails in case of need.

Having taken account of all dynamical considerations and decided upon a suitable driving equipment, we should next determine the energy losses in the motor in order to discover whether its capacity is sufficient for the service. This matter is treated in the following section. If the equipment is found suitable from this point of view, we may proceed to determine the exact particulars of the average schedule run, the energy consumption per ton-mile and per train-mile, and the maximum and average power taken by the train. If deemed advisable we may determine the train characteristics for a whole journey, including the effects of the actual grades, slowing down where necessary at curves and junctions, and generally investigating the most suitable manner of operation.

(To be continued.)

Gas Engines as Applied to Electric Driving.

By JAMES ATKINSON, M.I.Mech.E.

(Abstract of Paper read before the INSTITUTION OF ELECTRICAL ENGINEERS *at Manchester, January 30th,* 1906.)

IT is of great interest to realise how economically electric current can be generated when producer gas is used. As a typical instance the following particulars of three sets of engines with suction gas plants, made to the order of Messrs. Crompton & Co., of London and Chelmsford, will be of interest. The three plants were erected complete and tested by Messrs. Crompton's engineers before being shipped for Calcutta, where they are used for tramway work.

Each complete unit consisted of a gas producer in which common coke was burnt, two coke-filled scrubbers, a motor-driven rotary tar separator, a sawdust scrubber, and the engine directly coupled to a direct-current Crompton dynamo.

Each unit was tested finally on a six hours' run, one of such tests giving the following results:—

Total fuel consumed	488 lb.
Total KW.-hours	368·4
Fuel per hour	81·3 lb.
KW.	61·4
Fuel per KW.-hour	1·325
Thermal efficiency of the entire plant	22·75 %
Proportion of total heat in the fuel converted into electric current on the switchboard ...	20·87 %

The fuel used was ordinary gas coke.

An investigation as to the amount of irregularity in the turning moment will show what is permissible in a single cylinder "Otto" type engine, directly coupled to a continuous-current dynamo, giving steady lights and sufficient regularity to run two or more units in parallel.

Fig. 1 shows the turning moment on the crank-pin during the complete cycle. If we assume that work is being done by the engine at a constant rate, and include friction, which also may be regarded as being a constant resistance, the dotted line drawn

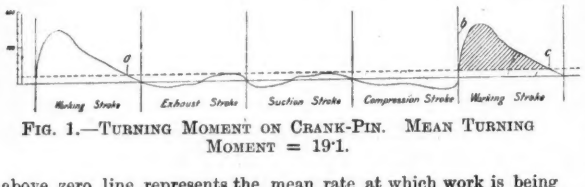

Fig. 1.—Turning Moment on Crank-Pin. Mean Turning Moment = 19·1.

above zero line represents the mean rate at which work is being done, and from this diagram the exact speed of the fly-wheel at any portion of the cycle can be ascertained. For the present purpose it will, however, be quite sufficient to ascertain the maximum and minimum speeds of the fly-wheel and the percentage variation.

Data for calculation:—Diameter of cylinder, 18 in.; stroke, 2 ft.; revolutions, 200 per minute. Energy stored up in fly-wheel and revolving parts, 720 ft.-tons.

From an inspection of fig. 1, it is obvious that the fly-wheel is being accelerated during the time from *b* to *c*, and that the amount of acceleration is due to excess work represented by the shaded portion. On calculating this excess it works out to 21·524 ft.-tons, therefore we have 741·524 ft.-tons stored-up energy at *c* as a maximum. The speed of the fly-wheel will be in the ratio of the square roots of these stored-up energies, and the fly-wheel at *c* will be moving at the rate of 1·492 per cent. faster than it is at the point *b*; from the point *c* the fly-wheel begins to slow down, though at a rate very much reduced from the rate at which the speed increased in passing from *b* to *c*. At the time of the next ignition it will be at its original rate of 200 r.p.m.

Should the engine be governed by "hit and miss" governing, and an impulse be cut out, it would fall below 200 r.p.m. by an amount corresponding to the loss of one impulse; this amount is 19·635 ft.-tons. The stored-up energy in the fly-wheel would drop from 720 to 700·365, representing a decrease in speed of 1·406 per cent. The 1·492 per cent. is what is commonly known as cyclical variation, and the 1·406 per cent. as governing variation. The cyclical and governing variation thus together amount to 2·898 per cent. Very extensive experience with a great number of installations has shown that this degree of irregularity is quite permissible. The extreme simplicity of "hit and miss" governing, together with the economical results thereby attained, make such an arrangement thoroughly satisfactory, and in many instances all that can be desired.

Governing by throttling a uniform mixture has been largely adopted, notably by the Westinghouse Co. of America and England, by many of the Continental firms and by other makers in England. It has the advantage of very great simplicity; it is effective and easily arranged.

The principal objections to this method of governing are: The great increase in gas consumption as the load decreases, such increase becoming a very extravagant amount on very light loads; on reduced loads, also, there is a considerable resistance during the suction stroke, causing a good deal of negative work; the reduced pressure at the end of the compression stroke interferes with prompt ignitions, and in some instances leads to reversal of strains in the moving parts owing to reduced compression.

Cut-off governing has been very largely adopted, a considerable number of large engines on the Continent having been governed in this way. In the case of these larger engines "trip" gears are used, being very similar in construction to "trip" gears as used in steam engines. Such governing has been very satisfactorily attained by this method so long as the speeds of the engines were moderate. It is, however, not suitable for engines running at high speeds.

Compared with throttle governing, there is very little loss from negative work; it also lends itself to combining the cut-off with "hit and miss" governing. This style of governing is open to the objection mentioned in connection with throttle governing, the reduced compression pressure under some circumstances not being sufficient to take up the inertia of the reciprocating parts.

Governing by varying the richness of the mixture is a method occasionally adopted, but it can scarcely be said to be generally used in practice. If either too rich or too weak, the gas is not properly burnt, and there is considerable risk of irregularities in the working of the engine.

The method of governing by varying the timing of the admission of the gas, but always cutting it off at the end of the stroke at the same time, seems likely to come to the front; it is being adopted largely on the Continent, and is the revival of an old method of governing introduced originally by the late Mr. Frank Crossley. Though differently carried out, the same method of governing is used exclusively in the Körting and Oechelhäuser types of gas engines. Messrs. Crossley Bros. are also constructing engines governed in this manner. To carry out this method satisfactorily, it is necessary to have a certain amount of stratification in the cylinder of the engine. This method also has the advantage of not decreasing the compression pressure, and there is no reason to suppose that it will be uneconomical.

The driving of alternating current dynamos is an altogether different problem; when they have to be driven in parallel, very much greater steadiness is required. In almost every instance inquirers and specifications for engines to drive alternators state that the variation in speed of the engine must not exceed some particular fraction of the mean speed, varying from $\frac{1}{150}$th to much smaller fractions, or ask what degree of regularity would be guaranteed. This is a wrong method of defining the necessary steadiness of such an engine. The required regularity is a function of the angularity difference between, say, the fly-wheel of the engine, and a fly-wheel running at absolutely constant speed. This angular variation is certainly due to speed variation, but it is speed variation qualified by a time element.

From inspection of fig. 1 it is obvious that the fly-wheel is at its lowest speed at the point *b*, corresponding to the commencement of the working stroke, and at its greatest speed at the points *a* and *c*, which is before the termination of the working strokes. In passing from *b* to *c* there is a much shorter interval of time than from passing from *a* to *b*; as the mean speed variation is the same, it is very obvious that during the longer interval from *a* to *b*, there must be a greater angular variation, the mean speed being the same. This, of course, is a somewhat exaggerated illustration, as an engine having so great a variation would be totally unsuitable for alternating current machine driving, but it illustrates the necessity for a clearer understanding as to the method of expressing the desired regularity of any engine for such purposes.

Engines giving two impulses per revolution will be mainly adopted for moderate powers, and for larger powers two such engines would be combined having their cranks at right angles. Fig. 2 shows the turning moment on the crank-pin of a vertical four-cylinder "Otto cycle" engine, the dotted line being the mean turning moment.

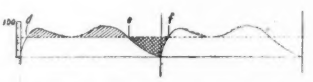

Fig. 2.—Turning Moment on Crank-Pin. Mean Turning Moment = 55.

In this engine the size of cylinder is taken as before, viz., 18 in. diameter with 2 ft. stroke, the revolutions being also 200, and the power of the engine, of course, being four times as great.

The diagram shown in fig. 2 shows what a remarkable effect the inertia of the four sets of reciprocating parts has upon the resulting turning moment on the crank-pin, the shaded portion between *d* and *e*, representing the excess of energy put into the fly-wheel, being such a small percentage of the work done during one impulse, the impulse giving as before 19·365 ft.-tons, and the excess being 3·39 ft.-tons; the deficiency from *e* to *f* being also 3·39 ft.-tons, the increase in speed takes place from *d* to *e*, and decrease from *e* to *f*.

Assuming that we have 610 ft.-tons energy stored up in the revolving parts when running at 200 revolutions at the point *d*, excess energy to the extent of 3·39 ft.-tons being added by the time *e* is reached, the speed at *e* would be increased in the ratio of the square roots of 610 to 613·39, which works out to a percentage of ·312 per cent.

From an inspection of fig. 2 it is evident that the fly-wheel compared with a wheel running with absolute regularity will be at its mean speed at a point between *d* and *e*, a little nearer to *e*, and again at a mean speed between *e* and *f*, a little nearer to *f*, changing from these positions approximately every 90°. In passing from the mean speed position to the most advanced position the fly-wheel is travelling at a speed varying between mean speed and maximum speed which is ·312 per cent. faster, consequently its excess angular advance becomes about $90° \times \cdot312/100 \times 2 = \cdot14°$. The retarded position will also be about ·14° behind the wheel of constant speed.

With such a small deviation it is obvious that it is not necessary to go into intricate mathematical calculations to ascertain more closely what the actual deviation is, as no alternator can possibly require such regularity as $\frac{1}{10}$th of one degree either way. As it is impossible to get absolutely equal impulses in all the cylinders under all circumstances, it is necessary to provide for such contingencies; therefore in this instance these contingencies are the controlling elements in deciding on the required amount of stored-up energy, not the cyclical variations.

The synchronising efforts of the alternators themselves assist in keeping them in step, and thus still further counteract any irregularity in the working of the engines.

The writer's firm has just completed a large double-cylindered, double-acting, tandem type engine, which is just finishing a series of careful and severe tests with a view to gaining information regarding this type of engine. So far the tests have been very

satisfactory. Each cylinder is constructed with a separate liner made of hard metal. The engine has exhaust valves counterbalanced so as to relieve operating strains; it is also fitted with automatic regulation which regulates the power per impulse down to any desired reduced load, below such loads the gas being cut out.

In the discussion, the Chairman (Mr. S. L. Pearce) said the subject of the paper was of special importance. There were three possible objections to the large gas engine: (1) Size of units—large steam-driven generators from 1,500 to 3,000 kw. were now running successfully, but there was no gas engine of that size; (2) There were no data in this country as to the running of alternators in parallel when driven by gas engines; (3) Total inability to deal with excessive loads.

Mr. Seaton considered that in plants of a capacity of about 60 kw. gas engines were very successful, but if the plants were of anything from 500 to 3,000 kw. they must take a back seat.

Mr. Miller said he had received a circular just lately stating that electricity generated by a certain gas producer plant cost $1\frac{1}{16}$d. per unit, but it omitted to state that the figure was only fuel cost. Gas engines were not so satisfactory in case of overload. Some time ago he had to go into the case of generating power for a large works by steam or gas, but he found that the capital cost killed the case for the latter.

Mr. R. L. Gamlen said that the floor space and weight of a large gas engine were much more than those of a turbine of equal power. He had been trying to get some reliable data as to suction gas plants. There was extra expense apart from the cost of the fuel; he knew of cases where the oil bill exceeded the cost of the fuel. In one case where his company were supplying power to a works that was originally driven by a gas engine, the cost of the gas alone was exactly double what the firm now paid for current. With regard to regularity of driving, he said that in the Electrical Review a short time back, two cards were given showing variation in drive. In the case of the gas engine, it was as much as 12 per cent., whilst in the case of the motor it was within 1 per cent. In Newcastle alone last year, there was a total of 800 h.p. in gas engines replaced by electric motors, and not one motor turned out by a gas engine. He quite agreed that in some places where electricity could not be had at reasonable rates it was advisable to put down gas engines. With regard to the gas-driven plant at the Blackpool Tower, a year and a half after the plant was put in there was a periodic variation of something like 15 volts on a 100-volt supply.

Mr. Southgate knew several places where alternators were running in parallel at 60 periods, driven by gas engines. Plants of 3,000 h.p. had been installed in several places. There was not so much chance for installing gas engines in places where there was already a steam plant working, but the capital cost of a gas plant was not much higher than that of steam if boilers, &c., had to be put down. In an entirely new installation the gas plant of to-day could be put in at about the same cost as high-speed engines.

Mr. Onions stated that he had seen four 450-h.p. gas engines at work in Holland, driving generators on traction work. Everything was running satisfactorily. He considered the method of throttling the charge a bad one, as it tended to create a vacuum in the cylinder. A steam engine would take about $1\frac{1}{4}$ lb. of coal per h.p. against $\frac{3}{4}$ lb. per h.p. with gas plant.

Mr. Hutchins said that it had been proved that with a suction gas plant, more power could be obtained per lb. of coal than with a steam plant. A great saving was also effected on capital cost, as the chimney, boiler seatings, and a certain amount of machinery were unnecessary. Two men could work a 1,000-h.p. suction gas plant, but they could not work a steam plant of that size.

Mr. A. P. Wood said he had lately been going into the question of cost of suction gas plants for the Lancashire Dynamo and Motor Co.'s works. Current at present cost slightly less than $\frac{3}{4}$d. per per unit, but from his figures he thought it could be done for about $\frac{1}{2}$d. per unit with a small suction gas plant. They intended to use it in conjunction with a battery and small reversible booster, and keep the load on the generator constant.

Mr. Atkinson, in replying to the discussion, said that the difference between the price of coal in this country and on the Continent had had a great deal to do with the adoption of gas plants there. In England they had started, and meant to make a good thing of them, but great difficulties had yet to be overcome. Pre-ignition was a serious thing in a gas engine, and when it started it might go on to a considerable extent. This had been overcome by admitting a spray of steam or water with the charge. On a test of a 510-h.p. gas engine a short time back, he found that to carry the whole plant through the test it would be necessary for the gas engine to give 600 h.p. This could never have been done, but for the water spray. His firm had used a tar separator which worked very satisfactorily. He believed the question of gas turbines would be solved before long. The governing at the Blackpool Tower was bad at first, but was now satisfactory.

Australian Customs.—The Australian authorities have lately given a decision to the effect that "Transformers sinusoidal—a combination consisting of a motor-generator, a static transformer and an electro-medical appliance—motor-generator and electrodes," are to be classified as "Machinery and Appliances n.e.i. electrical," the duty being 12½ per cent. *ad valorem*. On the other hand, static transformers are to be classed as "electrical material," and admitted free of import duty.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

The "Wind-up" Ceiling Rose.

The Edison & Swan United Electric Light Co., Ltd., in a recently issued leaflet describes the "wind-up" ceiling rose. It offers an improved means of raising and lowering light electrical fittings, whereby the movable fitting can be retained in any desired position without the use of balance weights.

Fig. 1.—Ediswan "Wind-up" Ceiling Rose.

The "wind-up" ceiling rose can employ fittings of varying weights with equal effect, as it is not upon the weight of the fitting that the working of the article depends, but upon the band brake arrangement, which can be clearly seen in the illustration. The entire mechanism is enclosed in porcelain, and perfect electrical contact is claimed to be made. It is easily wired.

Battery Wall Telephones.

The General Electric Co., Ltd., are just placing upon the market the "Enterprise," a cheap form of telephone instrument, which we illustrate, for offices, warehouses, factories, hotels and

Fig. 2.—The "Enterprise" Telephone.

general indoor use. The instrument is fitted with the G.E.C. new Manchester transmitter, with nickel-plated mouthpiece, induction coil, double-pole watch receiver, ringing key, buzzer and automatic switch hook. It is mounted on a solid polished walnut case, and all metal parts are nickel-plated.

The company are also introducing a new pattern Leclanché cell of the "Carsak" form, with semi-circular zinc (sack negative

element) for telegraph, telephone, bell, signal and all intermittent work. In this cell the dense porous pot is replaced by a pervious form of special container, inside which the carbon and manganese granules are packed by a special process.

Electric Desk Lamps.

The Concordia Electric Wire Co., Ltd., of 34, Queen Street, E.C., is supplying a new flexible arm electric desk lamp, as shown in the illustration. The flexible arms will remain in any required position, and can be instantly straightened and other curves made as needed. The utility of such a fitting for draughtsmen, book-keepers, and indeed anyone employed on very close work, needs no pointing out. We illustrate the single-arm form as supplied for roll-top

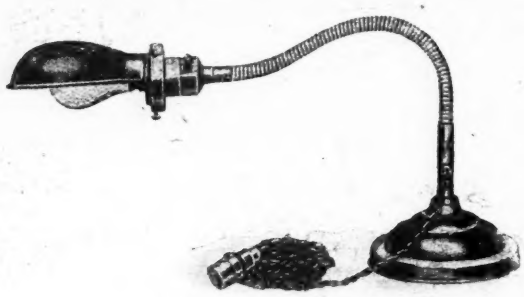

Fig. 3.—Flexible Arm Desk Fitting.

desks, pianos, &c., but a double-arm fitting is designed for other positions. The lamps have the base, lamp socket and shade carrier in polished brass, the flexible arm is dull nickel, and a green shade lined with white enamel is used. They are supplied in oxidised copper and silver, and other finishes if needed. A price list of the lamps has been issued by the company.

Terminal Sleeve for Leadless Cable.

A correspondent—Mr. F. G. Flint, of 56, Davenport Avenue, Withington—informs us that he has applied for a patent for the device illustrated in fig. 4. Having observed the deterioration of insulation of feeders in tramway manholes and feeder pillars through the effects of damp on the terminal lugs and cable ends, in the case of vulcanised bitumen and rubber-insulated cables, he proposes to apply the rubber sleeve shown in the figure. The sleeve is provided with a disk, so that water dripping on the cable and

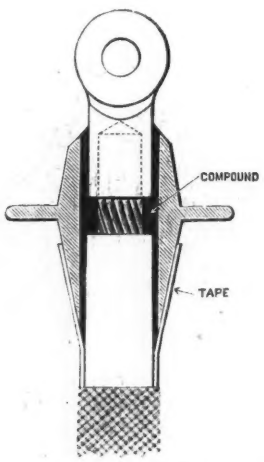

Fig. 4.—Terminal for Leadless Cable.

running along it will drop off at the disk. To fix the sleeve on the cable end, the insulation is pared off for ½ in. beyond the part which enters the lug, and the braid is removed for the full length of the sleeve. The conductor is then tinned to receive the lug, the sleeve is slipped over the cable, and the lug is sweated on. Afterwards the sleeve is brought up to its proper position, and filled up with hot compound, which is also painted over the lug and the back of the sleeve and cable end. Finally the back part of the sleeve is taped with tarred tape, and enamelled over the tape, so as to make a watertight junction with the insulation of the cable.

The "Juno" Flame Arc Lamp.

Messrs. Johnson & Phillips, Ltd., have recently put on the market this new flame lamp, for which claims of simplicity, neatness and novelty are made. It is of ornamental appearance and comparatively small size. There are only three moving parts, no shunt coils, wheels, sliding rods, clockwork, dashpots, brakes, clutches, or other mechanism likely to get out of order; the cost of repairs and maintenance is consequently reduced to a minimum. Any number of lamps can be run in series on either alternating or direct-current circuits, each lamp taking about 48-50 volts. The length of the lamp is 29½ in. overall; its weight is 19 lb.; and the length of carbons 18 in.

"Strut" Switches.

We recently paid a visit to the factory of the General Contracts Co., Ltd., at 62, Rosebery Avenue, E.C., where the manufacture of the now well-known "Strut" switch is in progress, and our attention was drawn to a number of improvements that have been made in this switch since we described it in its original form in our issue of December 4th, 1903. The general principle

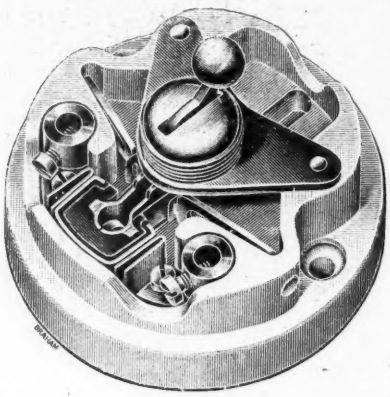

Fig. 5.—The Improved "Strut" Switch.

being already familiar to our readers, we may just point out wherein lie the improvements. As will be seen from fig. 5, there is now a china wall raised round all the live parts; further, in the porcelain base there is now a channel groove whose object is to guide the sliding contact; again, an improvement has been effected in the screw-down holes, which can be got at without damaging the china. The excellence of the design is best appreciated by actual use, and as our offices have been equipped with them for some 18 months, we can vouch for their good qualities on a 200-volt circuit.

We were shown a compact combination device, one base serving to carry a lighting switch, bell-push and plug; this combination is supplied with covers of high-class decorative designs. In addition to the improved Strut switch and its combinations, we saw, and here illustrate, a most ingenious little device in the shape

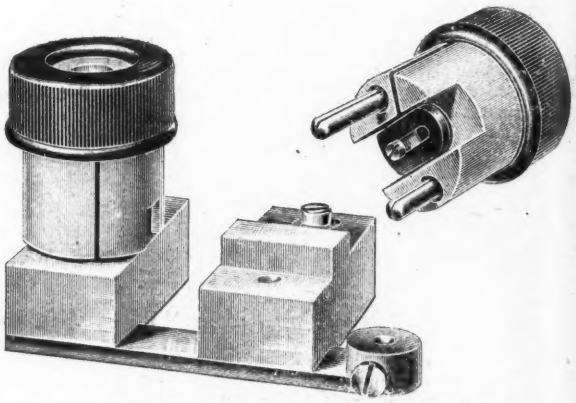

Fig. 6.—New Plug Fuse containing Bobbin of Wire.

of a plug fuse, which contains a spool of wire, so that instead of new wire having to be hunted for, as it often has to be in badly regulated establishments, where sometimes inferior substitutes take its place, a plentiful supply is available, comfortably and safely closeted away within the centre of the body of the plug; it can be unwound from the bobbin by pulling the end of the wire, without withdrawing the bobbin.

A switch on the Strut principle, enclosed in a waterproof case, has also been brought to our notice. In the cover of the case there is a second dolly, which works in a ball and socket joint, and carries a cupped end, into which the head of the switch dolly enters. The Strut switch is peculiarly suitable for this class of work, on account of its small height as compared with the majority of tumbler switches.

Among the firm's other specialities is a main switch, on the Strut principle, with carbon rollers, illustrated herewith.

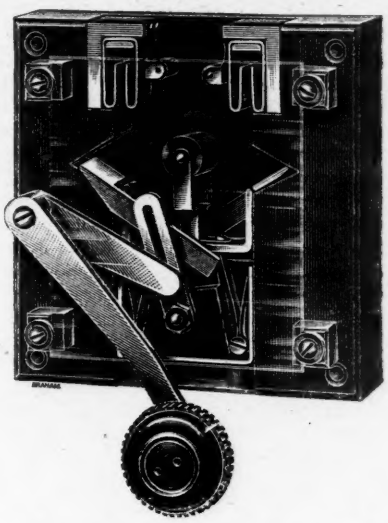

Fig. 7.—"Strut" Main Switch with Carbon Rollers.

The company has been receiving large orders for its "Strut" switches, especially for use on board ships, and a large contract has just been completed for the Admiralty.

ELECTRO-CHEMICAL AND ELECTRO-METALLURGICAL PROGRESS IN 1905.

By F. S. SPIERS, B.Sc., A.M.I.E.E.

(*Continued from page* 245.)

Lead.—In electrolytic lead refining, the Betts process still holds the field, and continues to make rapid headway. The plant at Trail, in British Columbia, where that process is used by the Canadian Smelting Works, has been extended to a capacity of 50 tons a day, and Trail now supplies Canada with $\frac{1}{4}$ in. to 5 in. pure electrolytic lead pipe. The solution, which is rapidly circulated, as now used, contains 5 per cent. of lead as fluosilicate and 10 per cent. of free hydrofluosilicic acid, glue being added to prevent "treeing," and to produce a beautiful crystalline deposit, although it has been maintained that the improvement is not merely due to the glue. Mr. Betts has recently been paying much attention to improving the methods by which the anode slimes are treated—a metallurgical problem of some complexity. Those particularly interested in this subject should consult an exhaustive paper contributed by Mr. Betts to the April number of *Electrochemical Industry*. A plant is now being erected at Montreal for making white lead, using the Betts product as raw material, and at Newcastle-on-Tyne Messrs. Locke, Blackett & Co. are installing a Betts plant for refining lead bullion.

Antimony.—The extraction and refining of antimony has likewise been the subject of experiment lately at the hand of Mr. Betts, and he has obtained some very interesting results by the employment of fluoride solutions. There is considerable room for improvement in the ordinary metallurgical smelting of antimony, so that further practical results from electrolytic methods will be awaited with great interest.

Gold.—The electro-metallurgy of gold will not detain us long; the writer is informed that since the South African war the Siemens & Halske electrolytic process for depositing gold from cyanide has not been re-started. Precipitation by zinc now seems to be universally employed on the Rand. In North America there appears now to be only two plants, both in Mexico, in which electrolytic precipitation is practised.

Zinc.—The smelting of zinc in a rational fashion—of course in an electric furnace—has always been considered by the electro-metallurgist as a problem coming particularly within his own province. It would be rash to say that ultimate success is even within view, but very decided progress in the electric smelting of zinc has recently been made. Leaving aside the hot chlorine process of Swinburne and Ashcroft, concerning which no new information is at present obtainable, that of de Laval, of turbine fame, is at present the most forward of the numerous proposals that have been made in this connection. This process, which utilises the radiant heat from an arc furnace, is in operation in Sweden, and de Laval zinc containing less than 0·1 per cent. lead, and therefore particularly suitable for the manufacture of high-grade brasses, has been for some time on the market competing with the purest Vieille Montagne and Sterling brands. Hitherto de Laval has been content to use his furnace chiefly for distilling impure spelter, but of late he is said to have treated successfully low-grade ores, and some time ago negotiations were reported to have been in progress for the introduction of his furnace into America. Whether he has really succeeded in overcoming the crucial difficulty of *condensing* the zinc, and not merely making zinc dust, ought soon to be made known. It is, by many metallurgists, considered probable that only the refining of zinc—as of copper and perhaps steel—and not its recovery from the ore, will ultimately be carried out electrically.

Another electric zinc smelting process to which some attention has been paid during the past year, is that of Oliver Brown & Oesterle, which has been tried on a laboratory scale at the University of Indiana. A charge of unroasted zinc blende, lime and carbon is heated in a resistance furnace according to the following equations:—

$$2\,ZnS + 2\,CaO + 7\,C = 2\,Zn + 2\,CaC_2 + CS_2 + 2\,CO,$$
$$2\,ZnS + CaO + 4\,C = 2\,Zn + CaC_2 + CS_2 + CO.$$

In some later experiments, in which the charge contained 3·98 kg. of blende, 2·24 of lime and 0·84 of carbon, only 0·1 per cent. of zinc was left behind in the residue. These experiments were carried out in a furnace 12½ in. × 8½ in. × 4½ in., and a current of 172 amperes at 68 volts was passed for nearly seven hours. Acheson electrodes led the current into the charge, and a carbon tube led the zinc away to the condenser. The process was described and discussed at the autumn meeting of the American Electrochemical Society.

Magnetic and electrostatic separation are, perhaps, likely to afford as much assistance to the zinc smelter as the methods of the electro-metallurgist, and thanks to these modes of concentration, many low grade ores, hitherto useless, are now being satisfactorily treated. In America the Blake-Morscher electrostatic separator is being more largely used, with what success it is impossible at present to say; and during the past year or two these machines have been installed in Denver, Park City and Butte. A new separator, the Dolbear, uses the high tension transformer as its exciting agent, and is said to show much promise. The special advantage of the electrostatic separator is that it can be applied for the concentration of such zinc ores as could not be treated magnetically without the preliminary costly and undesirable roast.

The Alkali Metal and Soda.—An interesting development in the use of the higher oxides of the alkali metals as ready and portable sources of oxygen, is worthy of record. The Niagara Electro-Chemical Co., who work the Castner sodium process, now sell cakes of fused sodium peroxide under the name of oxone, which, by-the-way, is stable in air, for the purpose of generating oxygen; 1 lb. of oxone yields, on treating with water, 59 litres of oxygen. As the caustic soda that is formed absorbs CO_2, it has been suggested that oxone might be used in submarine boats, so as simultaneously to create oxygen and remove carbon dioxide. The Roessler & Hasslacher Chemical Co. make the peroxides of calcium, magnesium and zinc. Each of these is supposed to have its special uses; CaO_2 liberates oxygen in the presence of moist organic matter, and it is, therefore, to be used, so it is suggested, for sterilising foods, ageing wine and spirits, &c.; MgO_2 is similarly to be used for sterilising water, while zinc peroxide is suggested as an antiseptic dressing. Another new alkali derivative, sodium perborate ($NaBO_3$), yields hydrogen peroxide when added to water, and this is being put on the market in America as a bleaching agent.

Sodium sulphate has long been considered to be in many respects a more desirable source of electrolytic soda than the chloride, on account of the by-product sulphuric acid.

Kelly has been experimenting on these lines, using a 3-compartment cell, the middle division of which it is essential should remain neutral, to prevent recombination of anode and cathode products; if these investigations yield satisfactory results, they will have considerable commercial value.

Tin Recovery.—As far as electrolytically detinning scrap is concerned, the alkali hydrate method seems, for the present, to have established itself as the favourite method, but it is possible that a fluosilicic acid solution, which has given such splendid results in lead refining, may be found equally useful in the case of tin deposition. Dr. Mennicke has been working along these lines, and his valuable series of articles in the *Electrochemische Zeitschrift* for 1905 should be consulted by those desirous of keeping in close touch with this branch of electro-chemistry. Dr. Mennicke points out that the present tendency is for tin-stripping works, which appear to have experienced the usual trouble in obtaining a sufficiently large supply of cheap scrap, to go in for the recovery of tin from slags, dross and smelting refuse.

Osmium and Tantalum.—The advent of the osmium and tantalum lamps, with efficiencies of considerably less than 2 watts per candle, has invested these rare metals with an importance that could not have been foreseen a short time ago. In both cases has the electric current or the electric furnace been pressed into the service of the filament maker. Pure tantalum was obtained by Bolton, the inventor of the lamp using this metal, by electrolytically reducing a filament made of the tetroxide (which is a solid electrolyte, like a Nernst filament) by means of a strong current in a vacuum. The oxide is really electrolysed, incredible as it may seem, pure oxygen—which has to be removed to prevent recombination—being given off from the filament until the latter is entirely reduced to the metallic state. In another method potassium tantalofluoride is electrolysed, and the metallic powder so obtained is heated *in vacuo* in an arc furnace made between electrodes of the material itself, to remove the oxides and the hydrogen present. Osmium filaments are made by squirting a paste consisting of the finely-divided metal and an organic binding material, and then, after carbonising, heating electrically in a moist atmosphere to remove the carbon in the form of water gas. At a recent meeting of the Society of Arts, Mr. Gaster exhibited, for the first time, a 1·2 watt per candle lamp containing a filament made of pure zirconium, another of Moissan's electric furnace products.

Before we leave the subject of lamp filaments, mention should be made of the important new carbon filament of J. W. Howell, which by heating to a temperature of 3,000° to 3,700° C. in a carbon tube furnace—to melt, and thus graphitise, so it seems, its outer coating—acquires an efficiency of 2·5 watts per candle. Thus is the electric furnace helping even the carbon filament to hold its own in face of its younger rivals.

Phosphorus and Arsenic.—An important laboratory experiment of Hempel is worthy of record. He finds that by electrically-heating, in a tube furnace, a mixture of tricalcium phosphate, silica and charcoal, a 92 per cent. yield of phosphorus can be obtained, and he concludes that on a large scale this (Woehler's) process, using, however, arc heating, and not a resistance furnace, will prove by far the best method of preparing phosphorus. Electric heating has recently made great progress in Germany, and the greater part, if not all, of the phosphorus made in the world is at present probably prepared in this way.

An ingenious method for making yellow arsenic has been described by Stock and Siebert. An arc is passed between an arsenic-antimony and a carbon electrode under carbon bisulphide. The arsenic, which volatilises, is dissolved in the carbon bisulphide, from which it can be crystallised out.

Organic Electrolysis.—Vanallin is now being made at Niagara by acting on oil of cloves with ozone. The method has been used in France for some years past. A considerable amount of work has been done on the electrolytic reduction of nitro compounds, and in this connection a number of patents have been taken out. On the other hand, electrolytic oxidation has, as in previous years, been much neglected, probably on account of the inherent difficulties of the subject. Still, papers on the oxidation of hydrocarbons have been read before the Faraday Society and the Chemical Society, and several processes for the electrolytic production of colouring matters have been patented, but it is difficult to ascertain whether they are really being worked industrially.

(*To be concluded.*)

EFFECTIVE SHOP LIGHTING.

By W. A. TOPPIN.

The effective lighting of shops is really a most important problem. Incandescent gas lighting has made such advances recently that it is a serious competitor to electric lighting. Passing through the streets of several of our large towns, I have been much struck with the fact that some shops using gas are much better lighted than others using electricity. Now, this is not as it should be, for electricity has so many advantages over gas that, if ordinary care is taken, an electrically-lighted shop window leaves nothing to be desired. It is not enough to put up so many incandescent lights inside the shop, and an arc lamp or so outside. The method of lighting should be adapted to the size of the window, and especially to the way the goods are arranged therein.

Certain classes of shops always arrange the goods in a similar manner. For instance, a fruiterer or confectioner generally places his goods in the bottom of the window, as shown in fig. 1. A most effective form of lighting for this type of shop is obtained by fixing short pendants to the ceiling and using silvered reflectors for the lamps. The light is all thrown vertically downwards, and the articles displayed are illuminated in a most perfect manner.

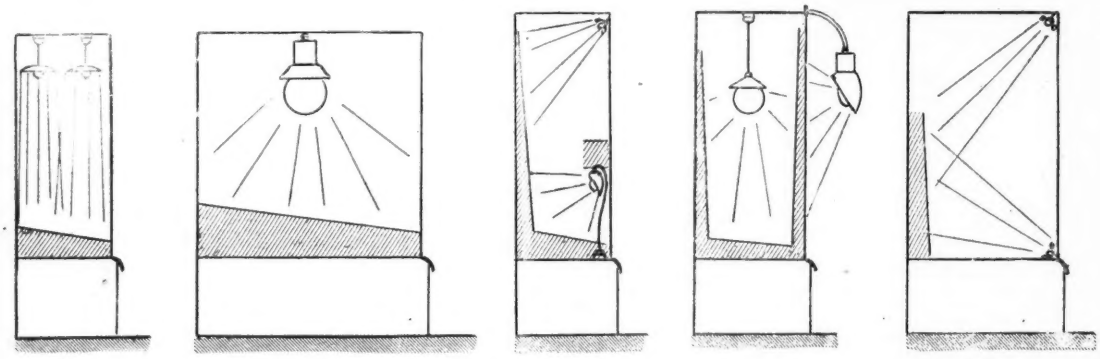

Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5.

Examples of Shop Window Lighting.

Tailors and furniture dealers have large windows, and the goods displayed extend back some distance into the shop. This type of shop is shown in fig. 2; and as the goods are placed in the bottom of the window, arc lighting is most efficient and economical. One enclosed type arc lamp is generally sufficient for each window. In fig. 3 a shop window is shown with the goods piled up to the top at the back of the window, and some on supports in the front of the window. Drapers', grocers' and stationers' shops are instances of this type. A row of Linolite lamps at the top of the window and plugs at the bottom supplying current to

movable lamps fitted with shell reflectors to illuminate the bottom of the window answers admirably.

Where the window is practically full of articles, the method of lighting shown in fig. 4 is suitable—a couple of small enclosed arc lamps fitted with reflectors, so as to throw all the light on the windows, and either Nernst lamps or the new type of incandescent lamp, *i.e.*, large circular frosted globes, inside the window. Gentlemen's outfitters and jewellers are examples of this type.

An art dealer or photographer's shop should have the means of illumination concealed as much as possible. A suggested method of lighting is shown in fig. 5. Rows of Linolite lamps at the top and bottom of the window will illuminate pictures placed at the back of the window very well indeed.

The interiors of shops do not require so much care in the choice of lighting. Large and roomy interiors are best lighted by enclosed arc lamps and smaller interiors by Nernst lamps.

Many shops use electric light in the windows and gas inside. This is bad practice from the central station engineer's point of view, as the light is required nearly all day inside the shop, and the window lights are only used when the load on the station is at its heaviest. The engineer thus loses just the load he is in need of, and gets a load he is not particularly anxious for. These shop-keepers probably use the gas inside the shop for the sake of the warmth it gives. They should be induced to use electric light, and be supplied with current for electric radiators at very cheap rates. This subject of the best methods of shop lighting is of interest to the central station engineer, as well as the contractor, for if people never see a badly illuminated electrically fitted shop, more people will be tempted to use electric light.

GERMAN SUBMARINE CABLE ENTERPRISE.

[FROM A CORRESPONDENT.]

The remarkable increase in German shipping, both naval and mercantile, and the general Colonial expansion during the last few years, has naturally led both the Government and commercial community to turn their attention to submarine telegraphy, and a very natural desire has arisen for German-made and German-owned cables landing whenever it is possible on German soil only, or at least on that of neutral or allied States.

To meet these demands, the well-known firm of Felten and Guilleaume took in hand the formation of a company for the making and laying of cables, and in 1899, founded the Norddeutsche Seekabelwerke Aktien-Gesellschaft, and established cable works at Nordenham, on the Weser. The location of these works was selected with great care, and proves to be eminently suitable. Nordenham is situated nearly opposite the great port of Bremerhaven, the headquarters of the North German Lloyd Co., the general manager of which is a director of the cable company, and whose good offices are of material assistance in the manning of their ships. Indeed, the company state that, partly thanks to this, within 24 hours of notice, either of their ships can be put into commission and ready for sea. In this respect they certainly have the advantage of all other cable manufacturing companies.

The banks of the river Weser are steep-to, and the deepest draught ships are able to lay alongside the works, moored to a short jetty, which is provided with railway lines and suitable appliances for the handling of heavy stores and other telegraph materials.

With characteristic good sense, our cousins, although they had been for many years in the habit of making short lengths of submarine cable, were careful to study the latest English methods, and did not hesitate to engage English specialists and to purchase English machinery and appliances whenever there seemed to be any advantage in so doing. Thus for their first ship, the *Von Podbielski*, they came to England and placed the order with Messrs. Dunlop, of Glasgow. This steamer was launched on November 9th, 1899, and took her name from the then Secretary of State for the Imperial German Post Office.

Before the new works were ready, however, an urgent demand arose for a cable between Tsingtau and Woosung, and necessitated its manufacture at Messrs. Felten and Guilleaume's works at Mülheim on the Rhine, from whence it was sent down to Rotterdam in barges and finally transported and laid by the *Von Podbielski* on her maiden voyage. In the meantime the Nordenham works had been completed under the direction of Mr. Ernst Diederichs, who had been appointed manager to the company, and after executing a small order for the Deutsch-Atlantische Telegraphen Gesellschaft, the company seriously began work by the manufacture of a four-cored cable for the German Post Office, in length about 300 miles, which was laid by the *Von Podbielski* in May, 1901, between Bacton (England) and Borkum (Germany), in the presence of representatives of both the Governments concerned.

In 1903, the company built a second ship of a cable-carrying capacity of nearly 5,000 tons, which was christened *Stephan*, after the late German Postmaster-General. No expense was spared to make this first telegraph steamer built in Germany a thoroughly up-to-date ship, and in every way she has proved herself to be so. Her first work was the second Atlantic cable between Germany and New York, for the Deutsch-Atlantische Telegraphen Gesellschaft, and during the laying of the Borkum-Fayal section of this the company paid its footing in the telegraph manufacturing world, and had the satisfaction of seeing their men and ships come out from the ordeal, both proved to be of the best quality. Unqualified and uninterrupted success is not an unmixed blessing, and as has been often remarked, the school of adversity is the best in which to learn, and neither a man nor a machine can be confidently relied upon until both have been proved equal to any emergency which is likely to arise.

The next section of the cable between Fayal and New York was successfully laid by the *Stephan* the following year without a hitch, and if the old dictum, "Happy is the cable that has no history" has any truth in it, then indeed the Norddeutsche Seekabelwerke and their clients are to be congratulated. This success was followed in 1905 by the laying of the German-Dutch cables in the Far East in so short a time and in so satisfactory a manner as to leave no possible doubt as to the efficiency of the company's staff, and the general excellence of the management of the whole concern.

Perhaps some details may be of interest. Leaving Nordenham on January 8th, 1905, the *Stephan*, with a length of 1,902 miles of cable on board, weighing 4,400 tons, reached Menado, in the Celebes Island, on February 25th, and on the following day started sounding northwards towards the Island of Yap.

This primitive little island of the West Caroline group, with its currency of stone disks, and pieces of pearl shell, and other delightful characteristics of Polynesia, was selected as an intermediate landing place between Menado and Shanghai, and in addition connected with Guam, a station of the American Commercial Pacific Cable Co. This last section was laid first by the *Stephan*, and it was completed on April 6th, after some delay, owing to a buoyed end breaking at a kink, and alterations to the route of the shore end.

The second section, Yap to Menado, was begun on April 17th, and completed without incident on the 26th. After landing spare cable into tanks, which had been erected at Menado and Yap, the *Stephan* took additional soundings towards Shanghai, arriving there on May 12th. These soundings, and those taken a year previously by the Dutch surveying ship, *Edi*, under the direction of Mr. Le Roy, a director of the German-Dutch Telegraph Co. and two officials of the Norddeutsche Seekabelwerke, I shall hope to say something more about at a later date.

The *Stephan's* next work was to lay out 113 miles of heavy cable from Woosung towards the Liu Kiu Islands, as part of the Shanghai-Yap section, to be completed on the next voyage. By the time this was done, the guarantee month for the two sections she had laid, had expired, and she made the best of her way back to Nordenham, arriving on July 11th.

As a result of this six months' voyage in the tropics, under

trying conditions, certain modifications in the accommodation were suggested, and were at once taken in hand and carried out at a considerable expense.

The *Von Podbielski* during this time was occupied with repairing operations in the North Sea and elsewhere, and also in the laying of the Constantinople-Constanza cable.

The second load of cable, 1,847 miles, weighing 4,360 tons, was shipped by August 23rd, and the day following the *Stephan* again sailed for the Far East. After a remarkably quick voyage she reached Woosung on October 5th, and on Friday, the 13th, after grappling and raising the end of the 113 miles laid previously, she spliced on and, favoured by remarkably fine weather, layed straight away to Yap without a hitch, buoying the end within six miles of the island on October 23rd, and finally completing the section a couple of days later. This success was all the more gratifying as it was by no means expected, the weather at this season of the year being generally so unfavourable as to make even laying operations dangerous. The Norddeutsche Seekabelwerke took the risk, however, and were rewarded, while the Telegraph Co. were enabled to open their cable for traffic five months earlier than the date specified in the original contract. More spare cable was landed here and the balance taken to Shanghai. Finally the *Stephan* got back to Nordenham on December 19th, thus completing her voyage in four days under the four months—certainly a remarkable feat.

The first expedition was under the charge of Mr. H. B. Forde, while the second was directed by Mr. J. Giessen. The *Stephan* was during both voyages most ably commanded by Captain Cornelius.

The interests of the Deutsch-Niederländischen Telegraphen-Gesellschaft were in the hands of Messrs. Clark, Forde & Taylor, who have been the consulting engineers for all cables manufactured in Germany, and it is needless to say that their clear certificate may be taken as proof that the work in every way satisfies the highest requirements.

At the same time that the *Stephan* was engaged with the Shanghai-Yap cable, the *Von Podbielski*, under her new name, *Telegraaf*, took out some 350 miles of cable, which was successfully laid by Mr. H. B. Forde and his staff between Makassar and Balikpapan for the Dutch Government.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

2,735. "Improvements in and relating to circuit closing arrangements for electrically driven suspended railway cars with hoisting gear." F. E. D. Acland and B. Greiff. (A. Bleichert & Co., Germany.) February 5th. (Complete.)

2,737. "Improvements in circuit closing for electrically driven suspended railways." F. E. D. Acland and B. Grieff (A. Bleichert & Co., Germany.) February 5th. (Complete.)

2,739. Improved trolley wheel with renewable centre for electric tramways." J. Aldworth, L. W. Crosta and W. Boot. February 5th.

2,757. "Improvements in connection with electric arc lamps." F. J. W. Purton. February 5th.

2,761. "Improvements in rotatory distributing contacts for electrical ignition in explosion engines." H. J. Simmons. February 5th.

2,763. "Improvements in mercury vapour electric lamps and processes for manufacturing the same." C. A. Lee. February 5th.

2,777. "Improvements in electrical fuse boxes." E. G. Anness and C. W. Denny. February 5th.

2,792. "Improvements in electric heating devices." The British Thomson-Houston Co., Ltd. (The General Electric Co., U.S.A.) February 5th.

2,794. "Improvements in the protection of electric circuits from excessive voltages." Siemens Bros. & Co., Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany.) February 5th. (Complete.)

2,862. "Improvements in and relating to the electrolytical manufacture of salts of oxy-acids of the halogens." W. Kusel and Deutsche Solvay Werke A.-G. February 5th.

2,823. "Process for electrolytically producing persulphates." G. Teichner and P. Askenasy. February 5th. (Complete.)

2,833. "Improvements in electrical direct-current generators and motors." S. Leech. February 5th.

2,850. "Improvements in electric generators and motors." R. Fabry and W. C. Mitchell. February 6th.

2,853. "Inspection sight for electric ignition spark." A. F. White. February 6th.

2,867. "An appliance to prevent the breakage of electric flexible wires at switch or lampholders." H. F. Pollard. February 6th.

2,887. "Improvements in the construction of electro-magnets." H. Lacy. February 6th.

2,902. "Nitration of cellulose by means of acid concentrated by electricity." Count G. C. de Briailles. February 6th.

2,928. "An improved construction of alternate or change-over tumbler switch." E. T. Davies. February 7th. (Complete.)

2,936. "Improvements in magneto machines for use in connection with ignition systems of electrically fired internal combustion engines." The Electric Ignition Co., Ltd., and F. H. Hall. February 7th.

2,944. "Improvement in electric indicators or annunciators." W. Aitken. February 7th.

2,956. "Improvements in electric flash or pocket lamps." W. Thomson. February 7th.

2,963. "An electric table game." T. Doddrell. February 7th.

2,989. "New electrolytic process for extracting metals from their ores and the treatment of copper waste for the recovery of pure copper." L. M. La Fontaine. February 7th. (Complete.)

2,993. "Improvements in or relating to the separation of particles of different dielectric capacities." H. M. Sutton. February 7th. (Complete.)

3,000. "Improvements in electric switches." C. E. Hunter. February 7th. (Complete.)

3,004. "Electric mixing furnace for mixing steel." Societe Electro-Metallurgique Francaise. (Date applied for under Patents Act, 1901, February 11th, 1905, being date of application in France.) February 7th. (Complete.)

3,026. "Improvements in electrical apparatus for transmitting angular movements or reproducing the same at a distance, especially applicable to telautograph apparatus." G. Isaac. (Date applied for under Patents Act, 1901, February 8th, 1905, being date of application in France.) February 7th. (Complete.)

3,028. "Improvements in electric make-and-break switches." G. H. Baillie. February 8th.

3,096. "Improvements in and connected with electric tramcars." J. A. Lycett and G. J. Conaty. February 8th.

3,119. "Improvements in electric stamp hammers." A. C. J. Guenee. February 8th. (Complete.)

3,127. "Improved apparatus for use in connection with electric wave telegraphy." G. Marconi and Marconi's Wireless Telegraph Co., Ltd. February 8th.

3,133. "Improvements in or relating to electrical insulators." G. Wilton. February 8th.

3,136. "Improvements in and relating to signalling systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 8th.

3,164. "Improvements in electrical switches." J. A. Kennedy-McGregor February 9th.

3,170. "Improved means for sealing the ends of electric light, traction and similar cables." F. G. Flint. February 9th.

3,172. "Improvements in ship's or analogous electric telegraphic apparatus." C. J. Montgomery. February 9th.

3,185. "Improvements in dynamo-electric machines." L. Torda. February 9th.

3,199. "Improvements in or relating to primary batteries." W. Thompson. February 9th.

3,213. "Improvements in and relating to the manufacture of incandescing bodies for electric incandescent lamps." A. Just, F. Hanaman, H. Landesberger, I Salzmann and Vereinigte Elektricitats Akt.-Ges. February 9th.

3,224. "Improvements in combined telephone receivers and microphones." C. E. Ljungman, R. O. Percival Berglund and W. A. W. E. Hjorth. February 9th. (Complete)

3,225. "Improvements in and relating to the manufacture of incandescing bodies for electric incandescent lamps." A. Just, F. Hanaman, H. Landesberger, I. Salzman and Vereinigte Elektricitats Akt.-Ges. February 9th.

3,239. "Improvements in operating and controlling quadruplex telegraph systems; also applicable to other telegraph circuits or systems." T. H. Berry and V. Berry. February 9th. (Complete.)

3,243. "Improvements in prepayment mechanism, especially applicable for use in connection with electric meters." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) February 9th.

3,249. "An improved automatic signalling apparatus for electric tramways or railways." W. C. Kirwan, K. Quaney, J. P. Tierney and J. Malone. February 10th.

3,258. "Improvements in electrical ignition apparatus for internal combustion engines." H. Bevis and H. J. Coates. February 10th.

3,268. "Improvements in means for operating electric controllers or switches and for imparting motion to other electrical and mechanical appliances or articles." R. F. Hall. February 10th.

3,316. "Improvements relating to the application of resistances for heating vessels, receptacles, radiators and the like by electricity." A. Voelker and J. Sulser. February 10th.

3,340. "Improvements in electric arc lamps." J. Brockie. February 10th. Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Interrupters for Making and Breaking Electric Circuits. A. L. Davis. 16,079. August 5th.

Electric Warning Devices for Doors, Lids of Deed Boxes, and the like. O. Roeseke. 17,881. September 4th.

Slow Speed Operating Mechanism for Electric Motor Starters and like Resistance Switches. Veritys, Ltd., and A. E. Goff. 18,620. September 15th.

Reflectors for Electric Arc Lamps. M. V. Ely and E. R. Grote. 19,719. September 29th.

Installations for Electrically Igniting the Charges of Internal Combustion Engines. A. E. Nicholson. 21,173. October 18th.

Electric Power Transmitting Mechanism for Motor Vehicles and like Purposes. British Thomson-Houston Co., Ltd., and B. Hopps. 320. January 6th.

Electro-Motors for Single-Phase Current. Akt.-Ges. Brown, Boveri & Co. (Date applied for under International Convention, January 8th, 1904.) 374. January 7th.

Secondary Batteries. P. Meusnier and G. Mounier. 521. January 10th.

Electrically Heated Curling Tongs. J. Maclean. 540. January 11th.

Method and Apparatus for Enclosing Electric Cables, Wires, and the like. H. Rosner. 1,863. January 31st.

Centrifugal Compressors or Fans for Air and other Gases. British Thomson Houston Co., Ltd. (General Electric Co.) 3,079. February 14th.

Electrical Means for Starting Prime Movers for Electric Generators and Controlling the Current. A. W. Sclater. 3,573. February 21st.

Means for Automatically Breaking an Electric Circuit in the Event of a Leakage to Earth. Nalder Brcs. & Thompson, Ltd., and A. F. Harris 5,073. March 10th.

Brush Holders for Dynamo-Electric Generators and Electro-Motors and other Electric Apparatus. Electromotors, Ltd., and J. H. Hamilton. 5,820. March 20th.

Electric Incandescent Lamp Holders. W. W. Strode and W. E. Halston. 5,948. March 21st.

Apparatus for Regulating the Pressure or Difference of Potential Between Direct Current Electric Mains. W. Buchanan. 6,260. March 24th.

Telephone Calls. E. Doye. 6,922. April 1st.